MORPHOLOGY AND PHYLOGENY OF THE WEEVIL SUBFAMILY BARIDINAE (COLEOPTERA: CURCULIONIDAE)

by

Steven R. Davis

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Advisor: Michael S. Engel

Committee members*

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Deborah Smith

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Edward O. Wiley III

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The Thesis Committee for Steven R. Davis certifies
that this is the approved Version of the following thesis:

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Table of contents

Chapter I: Morphology of Baridinae and related groups (Coleoptera: Curculionidae)

Steve R. Davis. Department of Ecology and Evolutionary Biology, Division of Entomology, Natural History Museum, University of Kansas, 1501 Crestline Dr. Suite #140, Lawrence, KS 66049-2811; email: steved@ku.edu

Abstract

Even though the phylogenetic classification of Curculionoidea is still in its infant stages, knowledge of the morphology of the group also is relatively lacking. Significant morphological reviews have been done at the family level; however, little has been reviewed at the subfamily level and below (beyond description of genitalia morphology). Morphological studies within the subfamily Baridinae are limited and have mostly been restricted to the study of genitalia morphology, provided a few exceptions. This study provides a fairly comprehensive, though by no means exhaustive, review of baridine external and internal morphology to aid future studies on the group, particularly in phylogenetics.

Introduction

Currently there are approximately 550 genera belonging to the subfamily Baridinae (Morimoto and Yoshihara 1996), placed into 9 tribes and 17 subtribes (Alonso-Zarazaga and Lyal 1999). Indeed the morphological diversity within Baridinae is vast (Figs. 1-96); however, baridines are quite easily differentiated from most other weevil groups by their characteristic round shape and ascended mesepimeron; however, these traditional diagnostic characters certainly are not apomorphic to baridines only, and beyond the level of subfamily, baridine identification is difficult at best. Due to the scarcity in knowledge of morphological diversity in Baridinae, the following is a review of baridine morphology. Although studies have been done examining the adult morphology of numerous weevil groups, such as those done by Morimoto (1962a, 1962b), Morimoto *et al.* (2006), and Franz (2006), none to date have treated Baridinae. With the exception of Morimoto and Yoshihara (1996), few baridine studies have illustrated structures that are beyond importance to the taxonomist (namely genitalia and some external features). Given the number of morphological characters one can sample from an organism is infinite, those of particular relevance to baridine phylogeny are the foci of this treatment. Because there have been no comprehensive studies assessing character systems for baridine weevils, those characters which are thought to be of phylogenetic significance are reviewed. The morphology of all structures covered within Baridinae is also described for taxa outside of the subfamily for comparison. Unless indicated otherwise, all morphological terms are reproduced from Morimoto *et al*. (2006), Morimoto (1962a), Morimoto and Kojima (2003), and Chaboo (2007).

Materials and methods

Taxon sampling (Appendix I)

Following Alonso-Zarazaga and Lyal (1999), species were sampled from each of the 9 tribes and 17 subtribes in Baridinae, with a total of 283 baridine species, representing 231 genera, included in the analysis (Table 1). A total of 29 species were sampled for the outgroup, consisting of 12 subfamilies outside of Baridinae. The final analysis included a total of 302 taxa (Appendix I). Outgroup selection was based on phylogenies produced by Marvaldi *et al.* (2002), and previous baridine classifications by Zherikhin and Egorov (1990), and Zherikhin and Gratshev (1995).

Taxa were borrowed from the following institutions:

USNM – National Museum of Natural History (United States National Museum), Smithsonian Institution, Washington, D.C., USA.

SEMC – Snow Entomological Museum, University of Kansas, Lawrence, Kansas, USA.

CMNC – Canadian Museum of Nature, Ottawa, Canada.

IZCAS – Institute of Zoology, Chinese Academy of Sciences, Beijing, China.

CAS – California Academy of Sciences, San Francisco, California, USA.

FMNH – Field Museum of Natural History, Chicago, Illinois, USA.

Specimen dissection and preparation

Body and genitalia dissection:

All dissections were performed using an Olympus SZ60 microscope. For each taxon in which multiple specimens were available, a full-body dissection was done for the male and abdominal dissection for the female (including genitalia). For taxa in which only holotype or paratypes were available (Table 2), no dissections were made and only external characters were coded. In some taxa, full-body dissections were not permited by the borrowing institution and thus only abdominal dissections were done for those males.

For body dissections, specimens were first relaxed by soaking them in warm water for ~10-15 minutes, the duration depending on the size of the specimen. The head, pro-thorax, meso- meta-thorax complex, and abdomen were then separated. Before digesting any internal tissues, the elytra and hind wings were removed and stored in glycerin, as digesting was not required for these parts. The remaining dissected parts were digested in a weak (~10%) KOH solution for 10-15 minutes, again depending on the size of the specimen. Following digestion, all remaining internal tissues were removed and the sclerotized parts cleaned. The meso- and meta-nota were separated from the mesepimera, metepisterna, and metepimera, and subsequently separated from each other. The terga were separated from the sterna along one side, and the genitalia removed together with the 8th terga. After dissections were completed, all parts were stored in glycerin.

Mouthpart dissection:

Following dissection of the body, the head was digested further in 10% KOH for ~15-30 minutes, depending on specimen size. Under the microscope, the head was placed with the ventral side facing upwards. One pair of fine-tipped forceps was used to stabilize the rostrum while another pair was used to gently separate the postmentum of the labium from the submentum of the rostrum. The maxilla were subsequently removed in a similar fashion, separating them from the submentum at the cardo-submentum junction. The mandibles were then removed, separating them from the postcoila.

Hind wing and mouthpart preparation:

Following dissection of the hind wing from the thorax and mouthparts from the rostrum, these parts were then mounted on glass microscope slides for further examination. One hind wing from each body dissection was mounted on a slide in Euparal mounting medium. The labium, maxilla, and mandibles from the same specimen were mounted on the same slide as the hind wing, but in Canadian balsam. The slide was then placed on a slide warmer to dry the mounting mediums.

Scanning Electron Microscopy:

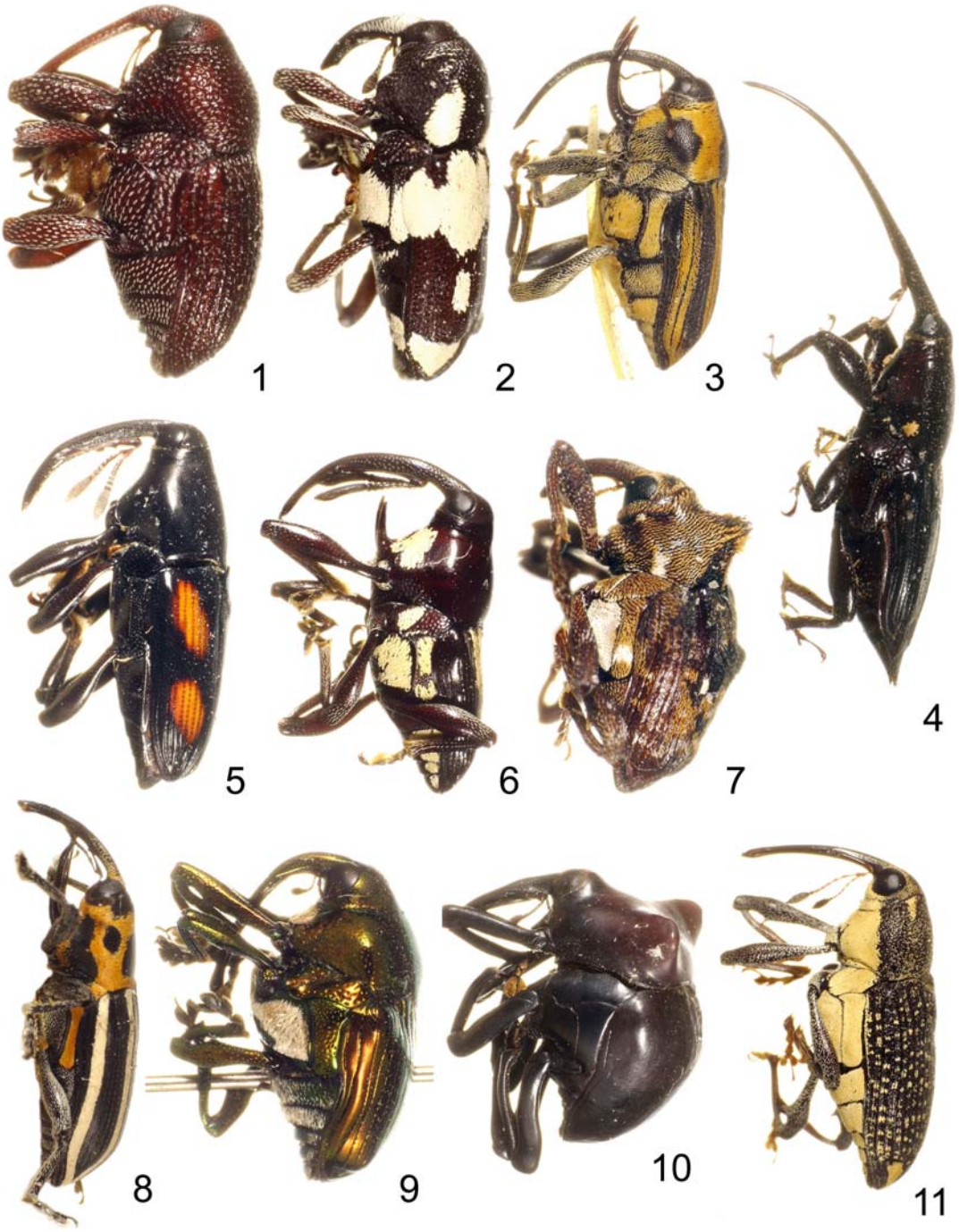
All SEM images were captured using a LEO 1550 FESEM. Specimens were mounted on an SEM stub using Leit-C-Plast adhesive and an isopropanol-based colloidal graphite. Whole specimens were placed on insect pins or glued to paper points, securing the pin or point on an SEM stub using Leit-C-Plast. Dissected parts

were mounted on a stub by securing them with a thin layer of colloidal graphite. After the desired parts were mounted, coating was performed using gold.

Adult morphology

General appearance (Figs. 1-42, 49-90)

Many adult baridines have a characteristic round or ball-like appearance, where all anterior, posterior, dorsal, and ventral margins are smooth and contiguous. This common body form usually is also complemented by a dark color (brown/black) and a largely glabrous derm. However, as one might expect from any large insect lineage, there are many aberrant taxa that fall beyond the stereotypic form. For instance, the body can be relatively round as viewed dorsally and laterally (Figs. 97-100); round as viewed dorsally, ball-like and strongly arcuate as viewed laterally (Figs. 101, 102); round as viewed dorsally, dorso-ventrally compressed as viewed laterally (Figs. 103, 104); elongate as viewed dorsally, relatively round as viewed laterally (Figs. 105-107). In the dorsal view, although many taxa have a round appearance formed by the pronotum and elytra, this round quality can be quite different when making comparisons, mostly due to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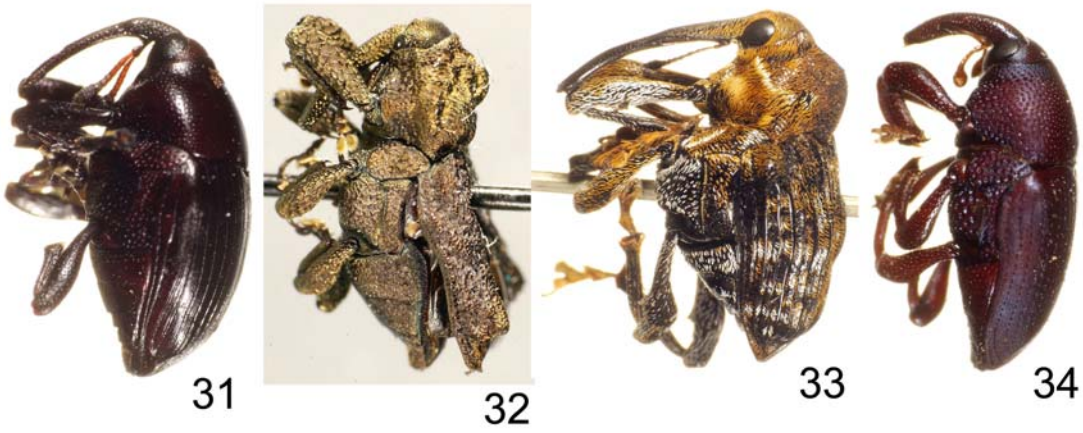
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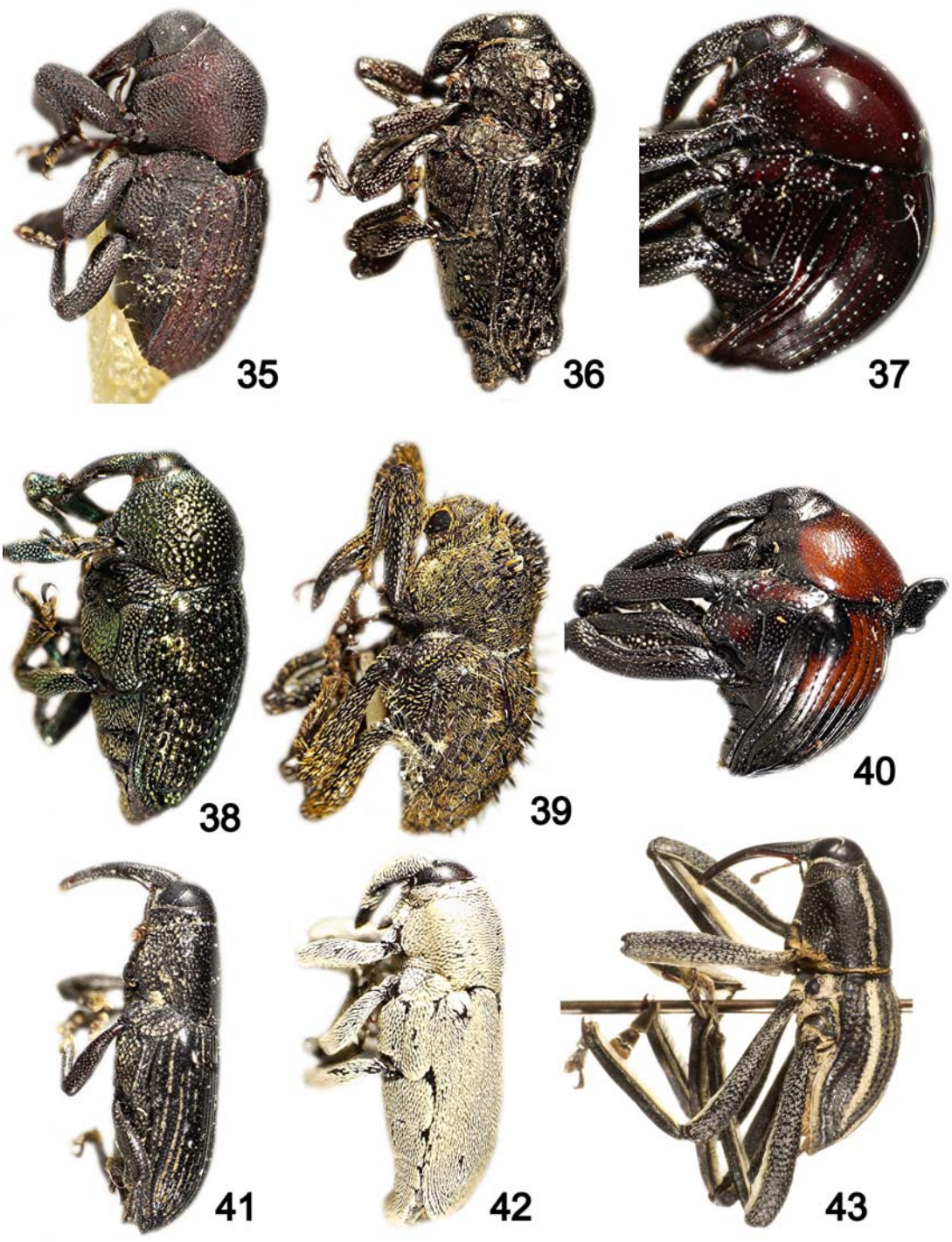
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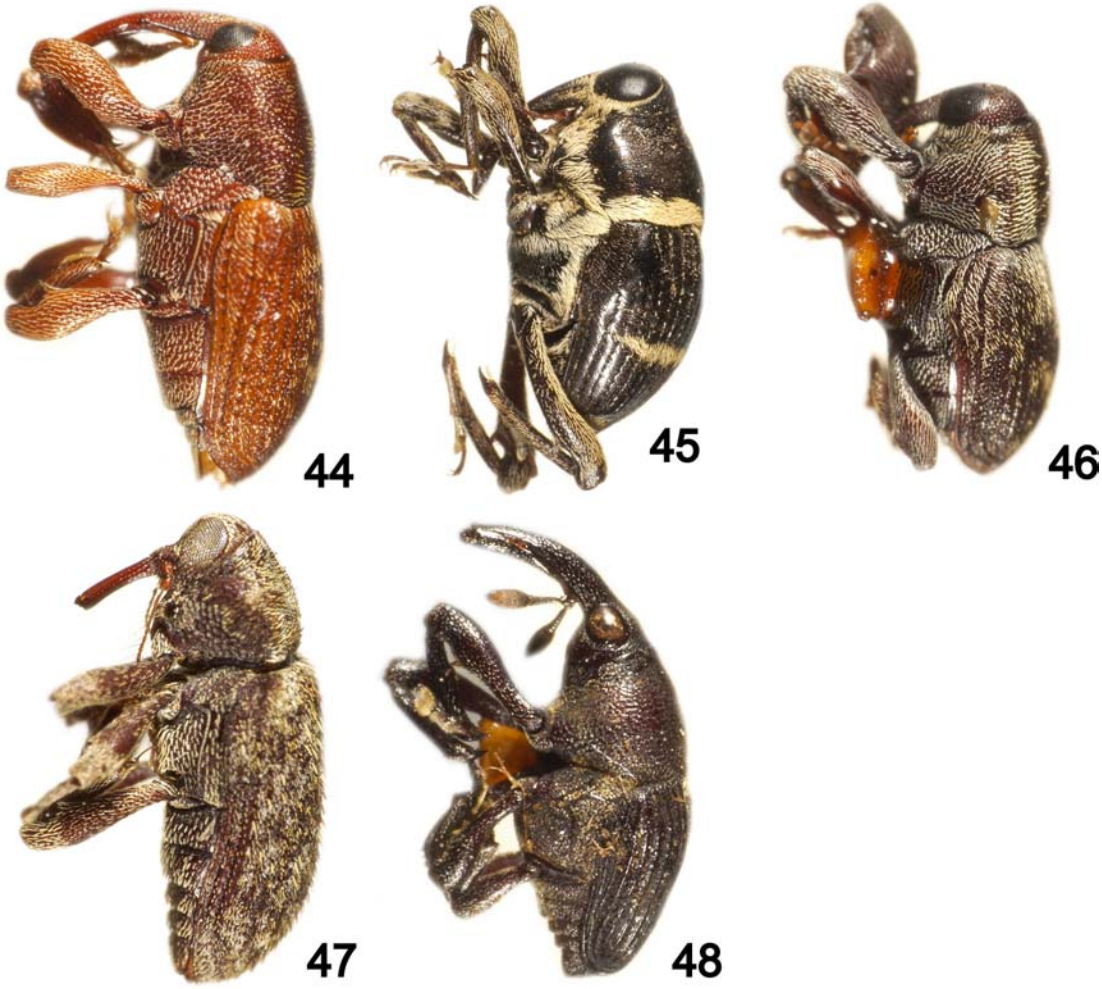
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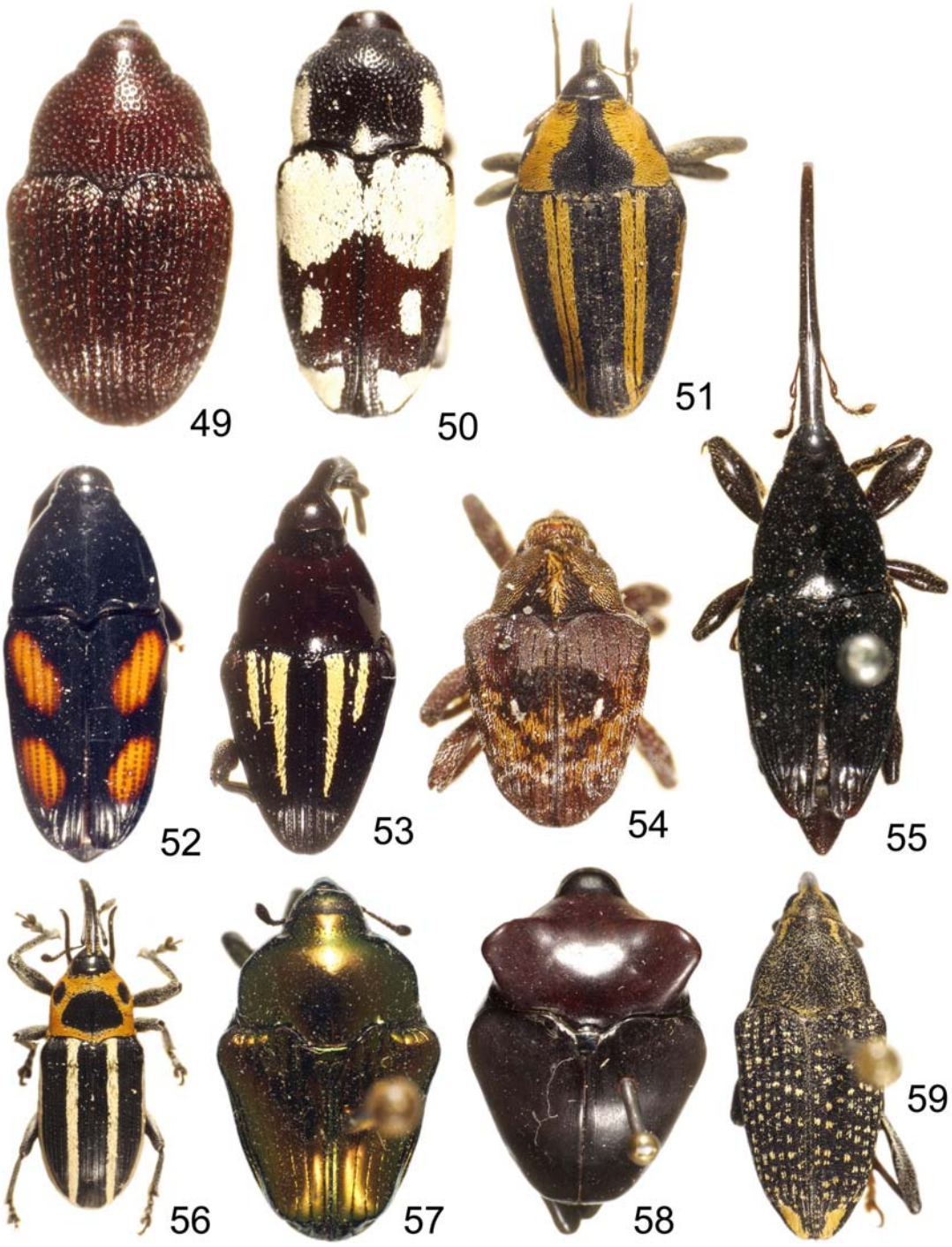
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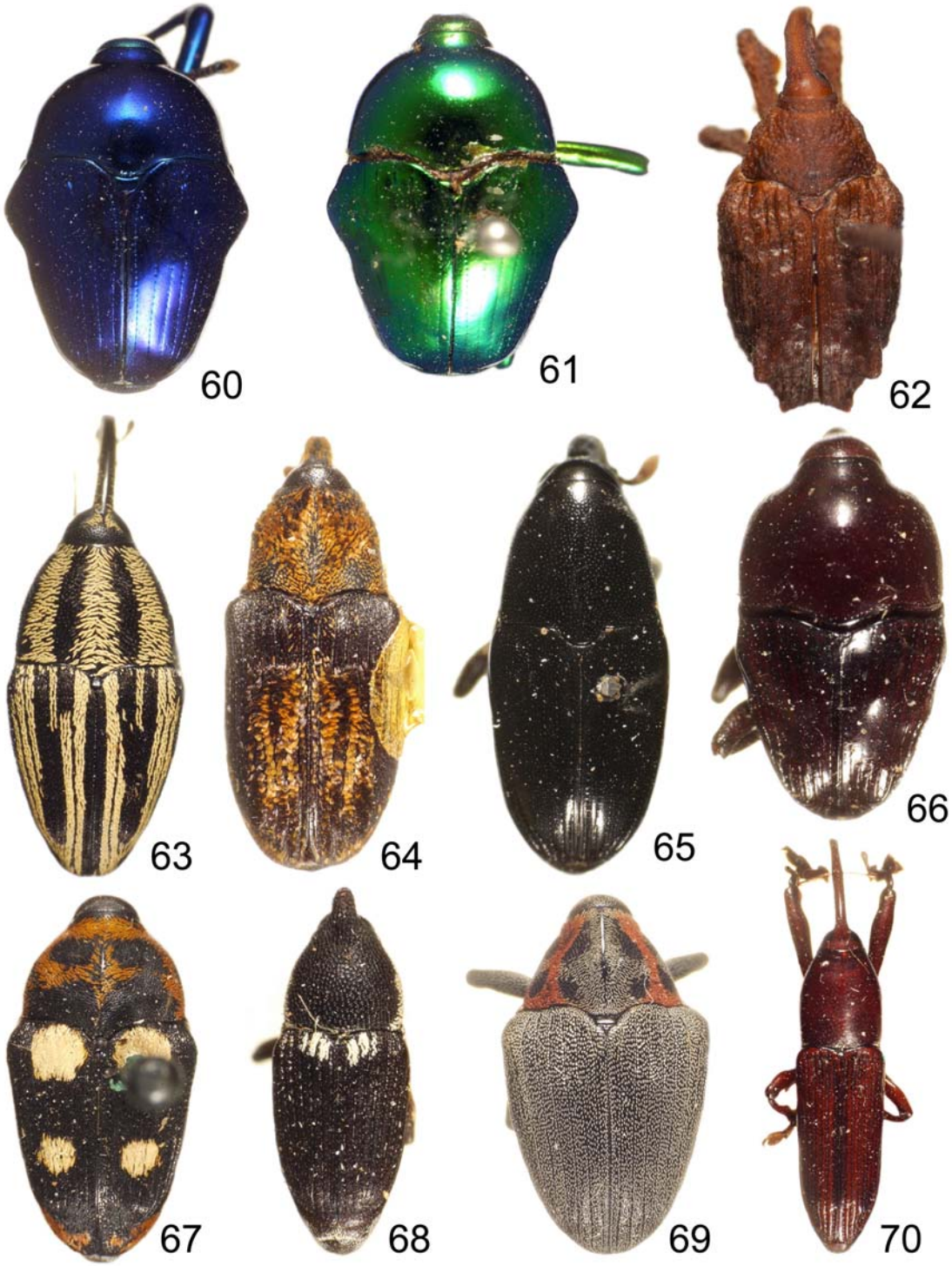
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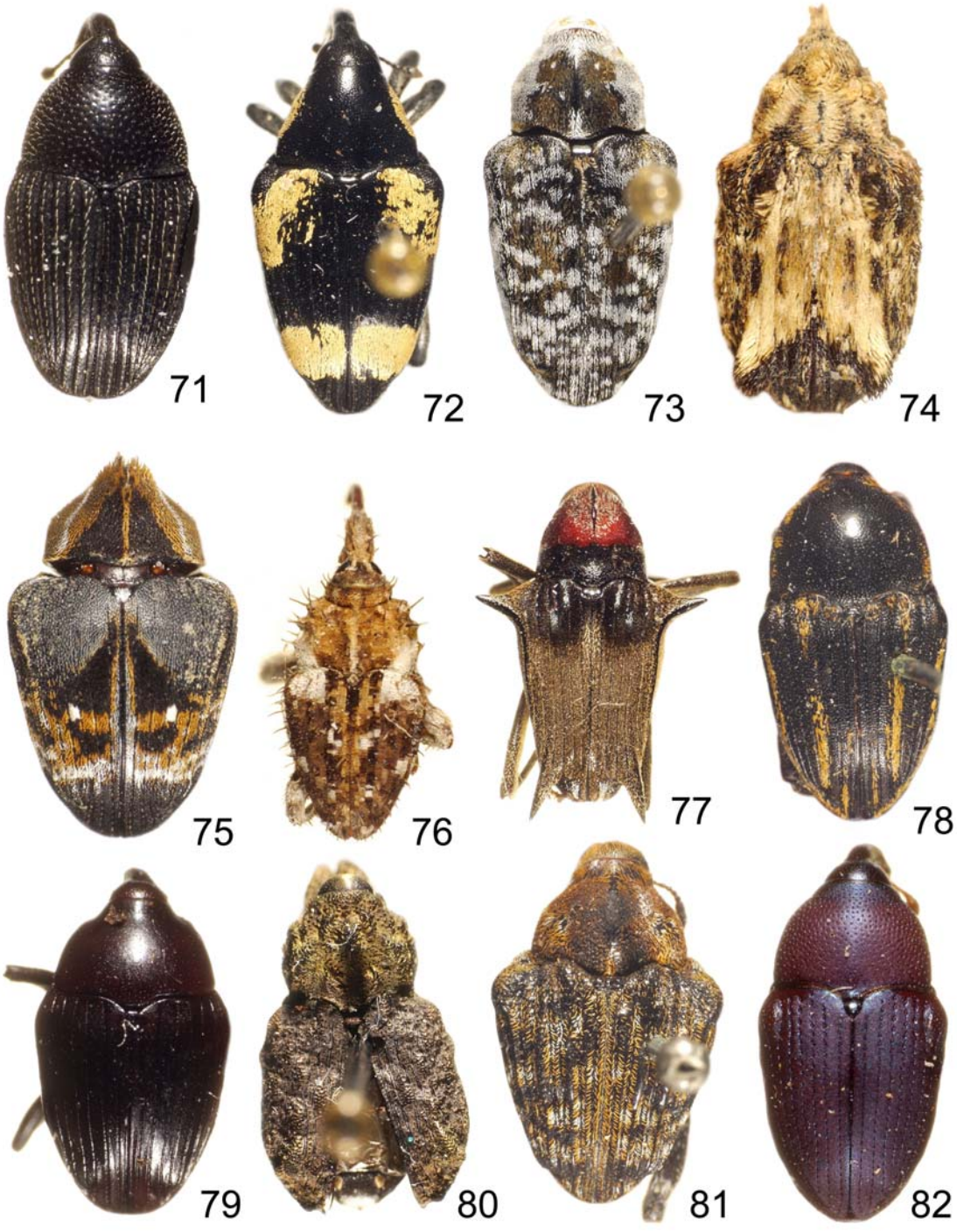
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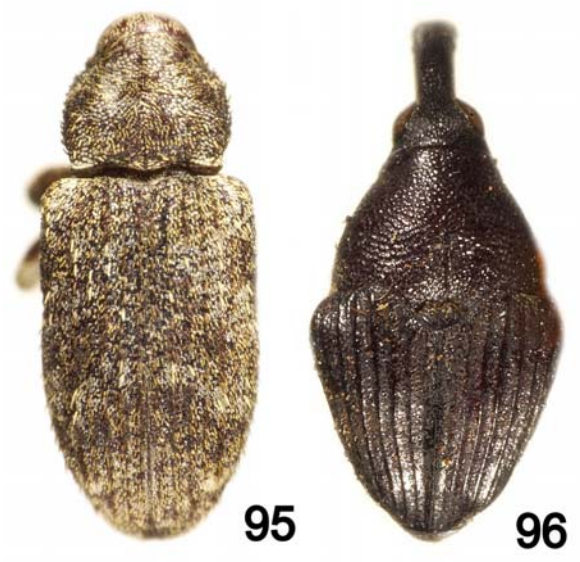

contrasting size ratios of the posterior margin of the pronotum and anterior margins of the elytra. A round appearance is formed in the following ways: the posterior margin of the pronotum is narrower than the elytra, mostly due to wide, projecting elytral shoulders; the posterior margin of the pronotum is contiguous with the anterior margin of the elytra; the pronotum is slightly expanded laterally, thus wider than the elytra.

Many baridines are largely glabrous, in which the derm is bare dorsally, with scales usually present laterally and ventrally in each cuticular puncture. Few, though, actually appear to be entirely glabrous (Fig. 109). The majority, however, have varying degrees of vestiture on the pro-thorax, legs, abdomen, and elytra (Fig. 108).

Scales (Figs. 110-126, 131)

In Baridinae, variously modified scales are present on different areas of the body. Typical scales present on the thorax, elytra, and occasionally on the venrites are ribbed, often with short, acute projections or spines along the lateral and apical margins (Figs. 113-118). These scales have varying numbers of ribs and can range from being narrow to broad and more rounded. Although scales mostly are appressed against the body, some taxa (*Plocamus*) bear ones that protrude from the pronotum and elytra and are more narrow and elongate (Fig. 110). Types of specialized scales include those present medially on the basal ventrites of some male taxa. These scales are quite distinct from surrounding ones on the ventrites, being erect and slightly elongate (Fig. 119). The apex of these scales seem to form fimbriate fringes (Fig. 120), suggesting they may function as a type of sex scale, possibly similar to those present in Lepidoptera. The tergites bear quite unusual scales, possibly owing to their involvement in fastening the wings. Those on the 7th tergite are usually fan-like with numerous long lobes projecting from the apex (Figs. 121-123). The spiculate patches, which are most developed on the 7th tergite but typically are present on most tergites in baridines, are also highly modified scales or setae, functioning in wing-locking (Figs. 125). Those scales modified for sound production, called plectra, are also present on the 7th tergite (Figs. 122, 124) and function by scrapping against a file on the inner side of the elytra. It is likely that some of the strangest scales in Baridinae are those along the ventral margin of the metepisternum-the sclerolepidia. Although observed to be modified into four general forms, baridines possess only two of these forms. One is usually trifurcate, but can have more furcations (~5) and is

more appressed against the body (Figs. 111, 112). The second form bears many fimbriate flanges along the apical margin and protrudes from the body. Further discussion on sclerolepidia is below.

Head and rostrum (Figs. 127-165)

The compound eyes in the majority of the genera are not particularly notable, as compared to those of molytines, ceutorhynchines, and conoderines which are large and anteriorly situated on the frons (Figs. 152-154). Those of baridines typically are elongate, although many genera possess sub-circular eyes, and are situated antero-ventrally (Figs. 137, 139, 149).

Between the compound eyes in some genera (*Peridinetus*, *Pteracanthus*, *Tenemotes*) is a fovea (Figs. 133, 138, 139, 149), which can be relatively large (i.e. the size of a puncture) or small (smaller than a puncture). A fovea is normally present when the junction between the rostrum and frons is flush.

The fashion of how the rostrum meets the head also differs between taxa. The junction between the rostrum and frons may be contiguous and flush (Fig. 165), form a slight depression or sulcus (Figs. 160, 161, 163), or form a strong sulcus (Figs. 156-159, 162). There is great variation with regard to rostrum form, both in length and width. The majority of baridines possess a relatively long rostrum, which is wider basally, gradually narrows apically, and is broadly curved, as viewed laterally (Figs. 156, 157). In some groups, however, this type is also present, but the rostrum is strongly curved (Figs. 158, 162). Punctation on these types of rostra follows the

general pattern of larger punctures present basally and punctures becoming smaller apically. A similar type of rostrum, possessed by groups such as *Crotanius*, *Dactylocrepis*, and *Myctides*, is again wide basally, gradually narrowing apically, only more elongate (Figs. 159-161). A few taxa (*Myctides*) possessing this type also bear an elongate, dense patch of setae along the apical region of the rostrum (Fig. 161). A modification of this moderately long, broadly curved type of rostrum is the enlargement or inflation of the basal part (Fig. 162). This type is distinct from the more gradually narrowing type in that the basal third or half of the rostrum is markedly enlarged, and the apical remainder abruptly narrower. Another more distinctive, but less common, rostrum form is shorter and thicker/more robust (Fig. 163). The last general type of rostrum is slender, linear (or only with a slight curve), and cylindrical, but can be dorso-ventrally flattened in some taxa (Fig. 164). Punctures on this rostrum type often are subequal in size along the length of the rostrum.

Antenna (Figs. 166-182): The baridine antenna bears 12 articles (Morimoto *et al.* 2006). The scape often is fairly elongate when inserted at the middle of the rostrum or beyond, but can be extremely short when inserted near the base. The pedicel always is longer than any of the individual flagellar articles. The flagellum consists of 6 articles, which may be almost moniliform and bead-like (Figs. 137, 149, 169) to cylindrical with the articles flush and often compacted (Figs. 144, 146, 177, 181). In most genera, the club consists of the remaining 3 articles; however, it may also be composed of 4 articles, in which the fourth article may be small and difficult

to distinguish. The club is of 2 general forms: the first, in which the club is compact, and the first basal article is longest, with the remaining 3 articles short (Figs. 168, 178); the second, in which all of the articles are subequal in length (Figs. 135, 171, 172). When this second type is observed, the club may be only slightly longer than the first type or may be elongate (Figs. 140, 151, 179, 180). In a few genera the flagellar articles may be modified, with lateral pectinations (Fig. 143), though any modification of the antenna is rare in baridines.

Mouthparts

Labium (Figs. 183, 186, 195-269): Although variation in the labium is seen in the length and size of the prementum, palpus, and setae on these parts, the number of palpal segments is static in Baridinae (3). The palpus is usually moderately elongate, but can be small in some taxa where the prementum is enlarged (Figs. 200, 206, 208, 233). The basal two palpal segments are large and globular to slightly elongate, while the third apical segment typically is smallest and elongate and bears a number (~5-10) of small sensilla on the apical margin (Fig. 190). Setae can be present on all three palpal segments, however the largest setae are present on the basal two. Those taxa possessing setae on the basal two segments often bear 1-2 larger setae on the first basal segment, while any other setae present on this segment are much smaller. The prementum typically is moderate in size, but can be smaller in some taxa where the palpus is elongate (Figs. 202, 210, 218, 222) and larger in others where the palpus often is shortened (Figs. 227, 234). Setae appear in 2 general

patterns on the prementum: the first is a sparse to dense bunch or patch of elongate setae along the anterio-lateral margins (Figs. 198, 203, 218); the second is a distinct transverse (although sometimes angled) row of setae near the anterior margin (Figs. 183, 201, 212, 225). Seemingly independent of the setal arrangement, there often are 1-3 larger setae positioned at the antero-lateral margins, similar to those on the first basal segment of the palpus (Figs. 234, 238, 239). The postmentum often is long, although its length, like the palpus and prementum, is proportional to the other parts. When the prementum is enlarged, the postmentum typically is shorter (Figs. 206, 208, 233, 244, 245). Likewise, when the prementum is smaller, the postmentum tends to be elongate (Figs. 205, 210, 218, 229). The labia in the outgroups (outside of Baridinae) tend to possess a much longer labial palpus, and thus also a smaller prementum and postmentum (Figs. 247, 263, 269), although a few also possess an enlarged prementum and reduced palpus (Figs. 248, 262). The labia of Conoderinae and Ceutorhynchinae all are very similar to those of baridines (Figs. 259-269), suggesting close phylogenetic relationships.

Maxilla (Figs. 184, 186, 189, 270-352): The shape of baridine maxillae is relatively conserved, and variation is seen in shape, relative size of the various parts, as well as number in reference to setae. The palpus always is 3-segmented and relatively long, though it may be shorted and more compact in some taxa (Figs. 285, 299, 325). Setae are found on all palpal segments, but mainly are concentrated on the basal two. The basal two palpal segments tend to be larger and slightly compact, while the third apical segment often is elongate and narrow, with numerous (5-12)

sensilla along the apical margin. This apical segments also bears elongate sensilla that are positioned laterally (Figs. 187, 189, 278, 345) and vary in number between taxa (~3-20). While setae on the basal two segments is often sparse, when setae are present, there usually are 1-2 larger setae at the apico-lateral margin (Figs. 273, 289, 296). The palpiger is relatively uniform in shape and size, although it can be slightly smaller or larger in taxa. Setae are most often present and are arranged in 3 general patterns: the first is a sparse patch of elongate setae along the anterio-lateral margin (Figs. 276, 279, 286, 288, 289, 296); the second is a fairly dense scattering of setae throughout the palpiger, including along the lateral and anterior margins (Figs. 274, 277, 317, 323); the third is a distinct transverse row of setae near the anterior margin (Figs. 272, 294, 322). Also appearing independent of the setal arrangement, there often are ~1-3 large, elongate setae positioned at the antero-lateral margin of the palpiger (Figs. 289, 297, 309), similar to those on the first basal segment of the palpus but larger. Only in a few taxa do these enlarged setae appear absent (Figs. 274, 289, 299, 300, 321). The cardo and stipes are conserved in shape and size, although they may vary in length. The stipes often bears 1-3 elongate setae, though these may be absent. The lacinia and galea are separate, with the galea slightly more developed. The lacinia often possesses some elongate setae, although the majority of setae are present on the galea. Setae on the galea are seen in 3 general types: the first being massive, teeth-like setae that vary in shape and size, some elongate and rectangular (Fig. 322) and the others triangular (Figs. 272, 298, 317). This type is only found along the lateral margin of the galea and often in a dense row. The second type are

smaller setae, though still slightly enlarged, and they are found interspersed throughout types one and three, though mostly situated posterior to type 1. The third type of setae are more normal in appearance, thin and elongate, and are interspersed throughout the first and second type. This third type is the only one present along the posterior region of the galea and the anterior portion of the lacinia (Figs. 281, 304, 310, 318). Maxillae in the outgroups are very similar to those in Baridinae, especially when considering the great diversity within Baridinae. Within the bounds of taxa studied, only maxillae in Entiminae were found to distinctly differ (Fig. 326). Although certainly not particular to Baridinae, the tendons attaching to the maxillae are quite long and notably fascinating, narrow while extending throughout the length of the rostrum, then suddenly widening for attachment to the tentorium (Fig. 432).

Mandibles (Figs. 185, 191-194, 353-431): Mandibles in Baridinae are quite variable, although this variation is fairly easy to categorize. Mandibles, in the case of baridines, can be atomized into bearing a variable number of incisors and a molar region. The right and left mandibles are consistently different, often not only in the number of incisors but also in shape. The difference in incisor number between the left and right mandible is one, with the right mandible always bearing one more incisor than the left. When comparing the right mandible only, incisor number varies from 1-3. In regards to a mandible with 1 incisor, this quality is also variable because there distinctly are taxa with 1 incisor and a molar region (Figs. 362, 370) and then there are taxa with a fused incisor and molar region (Figs. 368, 388). Mandibles bearing 2 (Figs. 361, 366, 376) and 3 (Figs. 355, 367, 374, 384, 395) incisors and a

molar region are unambiguous. In accordance with incisor number, the mandible also forms two general shapes, which can be determined from the striations present on the incisors. The first is a more or less linear shape, where the first incisor is enlarged and straight, with any other incisors and the molar region positioned laterally (Figs. 359, 366, 376, 378, 388). The second shape is angled or curved, where the incisors and molar region all fall on a lateral or angled axis (Figs. 357, 363, 383, 391, 410). In this second type, the incisors vary in size, in which the first, second, or sometimes even third incisor may be larger than the others. A curious form that has been found in a few taxa is what appears to be the presence of a deciduous tooth on the first incisor (Fig. 399). This tooth is thought to be deciduous due to ease in detaching it from the remainder of the mandible. Another peculiarity is the presence of strong lateral lacerations on the incisors (usually the first) (Figs. 360, 366, 374, 388). These cuts can penetrate quite deep into the incisor and often can lead to detachment of the apical half of the incisor (Fig. 370). It is possible that these marks form as a result of generalized feeding, but exactly how they come to be is unknown.

In the outgroups, the mandibles tend to be quite different from the general baridine types, mainly due to shapes of the mandible and incisors (Figs. 406, 409, 411-414). Those mandibles most similar to ones in Baridinae include Ceutorhynchinae and Conoderinae. Again, although not particular to Baridinae, the tendons attaching to the mandibles are worth noting (Figs. 433, 434).

Proventriculus and associated internal structures

The structure of the proventriculus is quite conserved within Baridinae and in related genera outside of the subfamily (Figs. 435-450). The only observed variation is in shape, where it can range from short and round (Figs. 442, 446, 447, 450) to elongate and cylindrical (Figs. 435, 439-441, 444).

Other internal structures are illustrated in Figs. 451-459 (according to Snodgrass 1935), including the various divisions of the digestive system and the ventral nerve ganglia (Fig. 458).

Pro-thorax

The pro-thorax in baridines is usually narrow anteriorly, widening posteriorly, as viewed dorsally (Figs. 460); however, in some groups it is widest at the middle and narrower both anteriorly and posteriorly (Figs. 461). Punctures most often are round to slightly elongate (Figs. 462-464), although in some taxa the punctures become oriented in such a way as to form a pattern of longitudinal ridges, normally only present on the pro-notum (Figs. 465, 466). Along the collar there typically is a ring of punctures that varies in size and puncture-depth among genera. The punctures are small and shallow along the dorsal portion of the collar and become large towards the ventral side, sometimes terminating in two large punctures anterior to the pro-coxae (Figs. 471, 472). Some taxa possess a puncture collar that is developed, with large, deep punctures (Figs. 467, 469, 470), others possess a weakly developed puncture collar, where the punctures are nearly absent (Fig. 473), but the vast majority have a puncture collar that is intermediate between these two extremes (Fig. 468).

The pro-notum may possess various modifications of the typical form. In most genera there is a central, longitudinal smooth line which does not bear any punctures or scales (Figs. 463-465). This line may be absent in some taxa, in which case punctures and scales are evenly distributed across the dorsal surface (Figs. 462, 466). Also along this central line there may
be a developed hump or crest (Figs. 474, 475). Although the pro-notum often is relatively flat and broadly convex, a more inflated and globular form may be present (Figs. 476).

The pro-sternum is typically flat and smooth (Fig. 483), often with a small depression along the anterior margin, bearing small lateral carina (Figs. 484, 485). Sometimes there may be a depression anterior to the pro-coxae or what may appear to be a highly reduced canal for the reception of the rostrum. When a canal for the reception of the rostrum is present it is always obvious and moderately deep, often with strong carina along the lateral margins. Although other related groups also possess a ventral canal (Cryptorhynchinae, Conoderinae), those present in Baridinae are restricted to the pro-sternum. The pro-coxae often are positioned relatively close (less than one diameter of a pro-coxa), although the inter-coxal distance varies from less than one to greater than one diameter of a pro-coxa. The prosternal process in baridines usually is developed, forming a quadrate process (Figs. 490, 494), a slightly concave process (similar to the quadrate process but with a slight concavity along the posterior margin) (Figs. 498, 499), or a bilobed process (or one with a central cleft) (Figs. 489, 491, 497, 500). The prosternal process may also be reduced, with a

posterior margin that is straight (or slightly curved), projecting (Fig. 493), or with a central cleft (Fig. 484, 488).

Also on the pro-sternum of many baridine taxa are a pair of horns. These horns have been observed to be associated with male-male sparring during mating competitions (Eberhard and Garcia-C. 2000). The horns themselves, although simple in structure, do not appear homologous across all of the taxa in which they appear. The horns can be cylindrical, dorso-ventrally flattened, and laterally flattened, and vary in length, from being small stubs or protrusions near the pro-coxae (Figs. 507, 508) to elongate tusks (Figs. 509, 510). Often also associated with these horns is an invagination between the pair in the middle (Fig. 501-506). This invagination often extends quite far posteriorly into the pro-thorax and can be a single invagination (Figs. 502-504, 506) or bifurcate (Fig. 501, 505). Although present in many taxa, the invagination can also be reduced to absent. The invagination can also be termed an acarinarium, as mites often are found dwelling inside.

Meso-thorax

Mesonotum (Figs. 511, 514-577): The structure of the mesonotum in Baridinae is relatively conserved, with most variation found in the mesoscutellum, followed by the axillary cord, the mesothoracic phragma and suture, and the anterior margin of the mesonotum. The central anterior margin of the mesonotum is always developed, a characteristic of baridines and related outgroups. In Baridinae the anterior margin can form an acute angle (Figs. 518, 528) or form a subacute

protrusion (Figs. 511, 522, 579-581). In most outgroups, this margin is reduced and relatively flat (not produced) (Figs. 563-577). The antero-lateral margins can also be different in form, being either relatively linear (Figs. 521, 534, 536, 543) or concave (Figs. 514, 518, 544). The mesoscutellum is quite variable in form in Baridinae. The anterior margin often is broadly round (Figs. 587, 592, 593) to quadrate (Figs. 585, 589, 590), but can also be acute, oval, or cardiform, with a central cleft (Figs. 582, 588). Likewise, the posterior margin is just as variable, being concave (Figs. 587, 590, 593, 599), concave with an acute central projection (Figs. 583, 591, 596), convex and broadly round (Figs. 582, 584, 600), acute, oval, quadrate (Figs. 585, 588, 589, 591, 592, 595), or cardiform (Figs. 586, 598). The axillary cord is produced and can either be round and lobe-like (Figs. 527, 537, 540, 541) or more truncate and quadrate (Figs. 522, 531, 536, 539). In most outgroups it is reduced and broadly rounded. The mesothoracic phragma bears a few areas that are different among taxa. The general shape can be quadrate (Figs. 518, 531, 547), longitudinally elongate (Figs. 526, 537, 541, 542), or

transversely elongate (Figs. 515, 521, 534, 543). The anterior margin may be continuous and smooth (Figs. 527, 531, 548) or may have a cleft of variable size at the longitudinal mesothoracic suture (Figs. 518, 535, 556). Punctures may be present on the entire or part of the surface of the phragma (Fig. 526, 529, 541), restricted to the anterior margin of the phragma (Figs. 515, 520, 543), or may be absent entirely.

Elytra

The elytra are of various shapes and length, ranging from moderately wide and short to slender and elongate. All elytra possess 10 striae along the dorsal surface, with variation seen in the punctures present along the striae and number and length of setae (Figs. 601-628). The intervals are typically flat, though may form elevated ridges in a few genera (Figs. 602, 605, 613). They also may be smooth (lack punctures), possess a single row of punctures (Figs. 614, 624, 626, 628), or possess multiple punctures not organized into rows (Figs. 612, 617, 623, 625).

The elytral suture is densely clothed with elongate setae (Fig. 629). Together with the spiculate patches on the abdomen and ventral surface of the elytra, these setae likely are also involved in a wing-locking function. Another feature of the elytral intervals of some taxa is that they appear to have small pores situated at regular intervals (Figs. 619-621).

Along the ventral surface, the elytra possess a number of particular areas where modified setae are present that function in securing the elytra to the tergites and thorax. While these areas are generally along the anterior, posterior, and outer margins, the most significant of these wing-locking patches are along the right and left anterior margins (Figs. 634, 635, 638-640, 652), the central region along the outer margin (Figs. 630, 631), and the outer apical margin (Figs. 632, 633, 636, 637, 641-651). The microtrichial patches along the anterior and outer margins consist of flattened, spade-like projections, whereas the apical patch consists of large spines that interlock with a corresponding patch of spines of the 7th tergite. Another particularly modified area is along the postero-medial margin where a file of 2 general types may

be present for involvement in acoustic communication. One type of file consists of many dense, parallel ridges (Figs. 648, 650), and the second type consists of fewer, more sparsely situated ridges.

Meta-thorax

As noted by Zherikhin and Egorov (1990) and Zherikhin and Gratshev (1995), the metepisternum and metepimeron are fused in Baridinae (Fig. 578). All baridines also possess the characteristic large, ascending mesepimera (Fig. 578).

Metanotum (Figs. 655-716): The thorax is a significant structure in terms of examining differences among baridine taxa. Although closely related groups to Baridinae possess a thorax similar in appearance, the baridine thorax is distinctively unique and has certain diagnostic

features. The anterior margin of the prescutum bears a pair of lobes, which may be large and protrude or small, reduced, and relatively undifferentiated from the prescutum. The lobes are separated by an invagination which may be shallow or deep. The anterior margin of the scutellar groove can be relatively flat and straight in some cases, but it mostly is broadly concave (Figs.

660, 671) or more laterally compressed transforming the concavity into more of a cleft (Figs. 664, 675, 679). In all of Baridinae, there is a central longitudinal crest on the scutellar groove. In many taxa this crest is well-developed and large (Figs. 668-670, 684), while in others it is reduced (Figs. 655, 666, 677). Related groups to Baridinae do not possess this crest. In a few taxa there is a transverse, sclerotized

bridge present at the anterior end of the scutellar groove. This bridge may be well-developed (Figs. 662, 663, 669, 678), partially developed (Figs. 655, 679), or absent (Figs. 667, 670, 685). The posterior margin of the scutellar groove may be straight, concave, or convex. The antero-medial margin of the allocrista is always rounded in Baridinae, whereas it is more angular to quadrate in related outgroups (Figs. 697-716). The shape of the metascutum is variable within Baridinae. It is always rounded, varying from subcircular (Figs. 655, 675, 679), transversely elongate (Figs. 662, 663, 669, 678), or to longitudinally elongate (Figs. 658, 664, 670, 680, 681). The postero-medial margin can be convex (Figs. 655, 671, 684), relatively straight (Figs. 661, 664, 665), or concave (Figs. 662, 666, 680). In a few taxa this margin can be strongly convex and forming an angular margin (Figs. 658, 673, 679). In Ceutorhynchinae and Conoderinae, the metascutum typically is transversely elongate, and the postero-medial margin quadrate or rectangular. This feature may be similar with the few baridine taxa that also share an angular postero-medial margin; however, taking the shape of the entire metascutum into account, all of the metascutal margins in Baridinae are rounded, while those in outgroups tend to be entirely quadrate, with the exception of Orobitidinae, which may be closely related. The metascutum may also bear small or large punctures, or punctures may be absent. The degree of development of the postnotum is closely related to the size and shape of the metascutum. In some taxa where the metascutum is subcircular or transversely elongate and its posterior margin well-defined, the postnotum usually is well-developed (Figs. 659, 669, 682, 686). When the metascutum becomes longitudinally

elongate and/or its posterior margin becomes less defined, the postnotum appears reduced to nearly absent (Figs. 661, 668, 680, 683). On the metascutellum, there can be a weak ridge or crest, here termed the metascutellar line, from the posterior end of the scutellar groove to the metascutum (Figs. 657, 659, 669, 689). In most outgroup taxa this ridge is absent. In all of Baridinae, the postero-lateral margins of the metanotum are developed and projecting, whereas taxa outside of the subfamily do not possess this feature and the lateral margins are straight (Figs. 697-716).

Metendosternite (Figs. 717-771): The typical form of the baridine metendosternite has a moderately short, quadrate metafurcal lamina (metafurcal stalk), which may be longitudinally or laterally elongate and always is wide (Figs. 717-719, 729-731, 740-743). Many taxa, however, have a metafurcal lamina in which the lateral margin migrates inwards towards the suture, creating an upside-down V-shaped lamina (Figs. 720-726, 736, 737). In this type, the metafurcal lamina is wide ventrally and narrows towards the metafurcal arm. The lateral arm is always well-developed in Baridinae, but sometimes reduced in outgroups (Figs. 755, 765, 767). The apex of the lateral arms may be simple (Figs. 717-719, 738-743) or bifurcate (Figs. 727, 729) in Baridinae. The anterior metafurcal tendons vary in their position, being adjacent to the longitudinal suture, approximately centered between the longitudinal suture and the base of the metafurcal arm, or closer to the metafurcal arm.

Sclerolepidia: Following Lyal and King (2006), there are four basic types of sclerolepidia found in weevils, two of these types are only found in Baridinae. One

type is composed of flattened, strongly appressed scales which are often trifurcate but also can be multifurcate (Figs. 772, 773, 776-780). The second type is composed of elongate, projecting scales that have fimbriate apices (Figs. 774, 775, 781-784). The specific function of sclerolepidia is unknown, but they are believed to be associated either with a secretory or sensory function.

Wing-locking patches: Dorsal microtrichia fields have been found in many insect groups and function as types of body-appendage arresting mechanisms through frictional forces as probabilistic fasteners (Gorb and Goodwyn 2003; Gorb *et al*. 2002; Gorb 1999; Gorb and Popov 2002). In Coleoptera, these fields are concentrated on the dorsal surface, particularly on the thorax and abdomen. As illustrated in other beetle groups, such as Tenebrionidae (Gorb 1998, 1999) and Carabidae (Baehr 1980), all baridines also possess interlocking microtrichia fields which function to fasten the elytra and hind wings to the body. While many tergites are modified with dorsal fields of spines (Figs. 785, 786) for interaction in wing fastening with corresponding areas on the ventral apical region of the elytra (Figs. 791-793), the thorax also plays a large role in this process. In Baridinae, the lateral region of the thorax just above the posterior area of the metepisternum possesses a microtrichial field for attachment to the ventral side of the elytra. This patch is composed of spade-like cuticular microprojections and is consistently found in all baridine taxa (Figs. 789, 790). The largest microtrichial field on the thorax involved in wing-fastening is located on each metascutum and is composed of similar spade-like cuticular outgrowths (Figs. 785-788). These fields interact with corresponding

fields on the inner antero-ventral side of the elytra (Figs. 794, 795) and setal spines on the hind wings (Figs. 796-799).

Hind wings (Figs. 800, 801, 803-845)

Following wing terminology of Zherikhin and Gratshev (1995), the baridine wing, like many other morphological features, is relatively conserved, in which mostly subtle changes are seen when comparing genera. Generally, the larger-bodied taxa retain greater sclerotization in the hind wing, and smaller taxa often show reduction in many of the veins and sclerotizations on the wing. For the most part, C, Sc, R, Cu, and A remain relatively undifferentiated among taxa. Rr is most often present and fully developed, although it may be reduced in length or even absent. The rfi is always present, but may be somewhat ambiguous in less sclerotized wings. The rc often is present, fully enclosed by the rcm, and may vary slightly in size. It may sometimes be open, though, due to discontinuities in the rcm. The sclerotized regions, particularly the rms, rsc, and msc are always present, but may also be inconspicuous in less sclerotized wings. The rm can be absent or present, but differentiating the two states may be difficult when the rm is faint. 1rs is always present, and can also be faint in many taxa, but 2rs may be present of absent. R3 is usually present as a thin, sclerotized vein (Figs. 815, 816, 821, 831), though it may lose the majority of sclerotization along its length and therefore take the form of a long, thin, white line (Figs. 800, 804, 812, 823). In a few taxa R3 is absent. The pst is always present and developed in the majority of genera, though it may become

narrower or slightly reduced in length medially (Figs. 810, 811, 825). The mst also usually is elongate and developed, but it too may be reduced in length medially (Figs. 808, 819, 825). Cu_1 never reaches the wing margin, and is extended by a light sclerotization at the apical fold of Cu_1. This sclerotization may become reduced in length apically. $1A_1$ and $1A_2$ usually are completely absent, though when present, they typically are only defined near the wing margin (Figs. 804, 806, 815, 821). In only a few genera, the $1A_1$ or $1A_2$ veins are extended dorsally towards A and fused by a_1-a_2 (Figs. 813), though both veins are never found to extend dorsally in the same instance. 3A in the majority of genera is reduced (Figs. 809, 819, 824), though it may be developed and nearly touching A (Figs. 805, 813, 815, 821, 826). 3A, however, is never fused with A in Baridinae.

Since the sclerites at the base of the hind wing in Baridinae have never been demarcated, they are illustrated in Fig. 801. Terminology follows that of Kukalova-Peck and Lawrence (1993), Browne and Scholtz (1995), and Fedorenko (2002). Particularly noteworthy is that Br and BSc are fused. In this illustration, Mr is visible, but cannot be seen well in the full-wing illustrations because of its short length and small size.

Legs

The pro-, meso-, and meta-femora are often bare and relatively similar in size. Sometimes one or more teeth are present near the apico-ventral surface, and the ventral surface may be sulcate for reception of the tibia. The tibiae usually are not

particularly modified and do not bear tarsal grooves along the apical surfaces, thus the apical setal comb will more or less form a complete ring around the apical margin (Figs. 850, 855, 856); however, in some taxa, such as species of *Fryella*, tarsal grooves are present for reception of the tarsi when they are folded. Variation is seen in the presence and absence of an apical tibial uncus. When an apical uncus is present, it most often arises from the inner angle and is accompanied by an adjacent tuft of elongate setae that converge with the uncus (Figs. 847, 849, 857, 858, 860). In some cases a small mucro may form from the inner carina adjacent to the uncus (Fig. 850-852). The uncus, however, does not always arise from the inner angle, and can also arise from the middle (Fig. 847, 858). In other cases the apex of the tibia may be bear, with both mucro and uncus absent. Although the uncus may be absent in some taxa, a mucro may be present at opposite sides of the tibial apex, on both inner and outer angles (Fig. 855).

The number of tarsi in baridines is 5. Tarsomeres 1 and 2 usually are cylindrical or conical (Fig. 853), although they may be dorso-ventrally flattened and expanded laterally (Fig. 854). Tarsomere 3 typically is bilobed, though the lobes may be highly reduced and appear more cylindrical. When lobes are present they vary in size between genera. When they are enlarged and expanded laterally, tarsomeres 1 and 2 usually are expanded as well. Tarsomere 4 is always reduced in size and inconspicuous. Tarsomere 5 always is cylindrical, but varies in length. Usually it is shorter when the lobes of tarsomere 3 are expanded (and often when tarsomeres 1 and 2 are expanded) and longer when the lobes are reduced in size. The ventral setal tufts

on the tarsus are as Figs. 862-864 The pre-tarsal ungues may be connate (Figs. 865, 867, 868) or divergent/free (Figs. 864, 866) and are always simple (not bearing any serrations or teeth).

Tergites (Figs. 802, 869-927)

A unique feature of Baridinae is that most taxa possess a strongly sclerotized tergum, in which the intersegmental membrane between the tergites is even sclerotized, forming a hardened shell. A few sister taxa to Baridinae also possess this strong sclerotization of the tergum. Only relatively few baridine taxa possess a weakly sclerotized abdomen, thus this feature appears to be plesiomorphic in Baridinae. There are 7 visible tergites in Baridinae (Morimoto *et al.* 2006). Each tergite is composed of 3 separate parts, the median sclerite, which is the largest, the spiracular sclerite, and the laterotergites (Fig. 802), which are small and each subdivided into many smaller sclerites. Median tergite 7 is never modified or subdivided, and its associated spiracular sclerite is always fused. Median tergite 1 is always divided in the middle, and these two separate sclerites are further subdivided into two parts. Median tergites 2-6 may also be individually separated with a median fissure in different taxa. The spiracular sclerites, as the median sclerites, may be individually fused or separated from the median sclerites. The laterotergites are always separated from the spiracular sclerites.

On the dorsal side of the tergites, as in many weevil subfamilies, spiculate patches (patches of spines) are found (Figs. 913-919). These patches are present only

on the median and spiracular sclerites, and there is variation found between taxa on which tergites they are present. Only the patches on the 7th median sclerite and lateral sclerites interact with corresponding patches on the postero-ventral and latero-ventral margins of the elytra, respectively. The other spiculate patches seem to interact with the hind wings.

Sound production, particularly by stridulation, has been described in numerous beetle groups (Kasper and Hirschberger 2005; Serrano *et al*. 2003). Such as described by Lyal and King (1996), in many genera of Baridinae, two longitudinal rows of plectra are present on the dorsal surface of the 7th tergite (Figs. 920-927). These rows are seen to be of two types, those that are composed of densely-situated plectra (Figs. 920-925) and those that are composed of sparsely-situated plectra (Fig. 926, 927). These two types of plectra correspond to the presence of two types of files on the apico-ventral surface of the elytra (Figs. 928-932). The type of plectra that form dense rows correspond to a file type that is composed of dense longitudinal ridges (Figs. 928, 930, 931). The second type of plectra, forming sparse rows, correspond to a file type that is composed of more sparse ridges (Figs. 929, 932). This type of combination of plectral rows and file is the most common among weevils, present in 13 other curculionid subfamilies (Lyal and King 1996). Although three other types of strigulating mechanisms are present within Curculionidae, only one type is found within Baridinae.

Ventrites (Figs. 933-980)

The ventrites (visible sternites) in Baridinae are relatively uniform, showing variation mainly in the shape of the posterior margin of ventrite 5. The posterior margin may be developed and rounded (Figs. 935, 937, 946, 948), truncate and convex, occasionally with a small central projection (Figs. 933, 945, 956, 957, 969), truncated and concave (Figs. 951, 952, 976), truncated and sinusoidal (Figs. 950, 958, 978), or truncated with a small central projection (Figs. 940, 971, 977, 979). Punctures covering the ventrites is normal, but punctures along the anterior margin of ventrite 5 may be present or absent (Figs. 978-980). In the majority of Baridinae, the posterior margin of ventrite 1 is sinusoidal, with the lateral parts convex and the central part concave. The posterior margins of ventrites 2-4 or broadly concave.

Male genitalia (Figs. 981, 982, 985-1043)

8th sternite: The 8th sternite in Baridinae is divided and forms paired sclerites, their medial margins rounded and distal margins often acute (Figs. 982). They most often are fairly wide (medial-distal length long) and have a short length (anterior-posterior length short) (Figs. 993, 995, 1008, 1009, 1013). In some taxa this pair of sclerites may be enlarged and more round (Figs. 986, 989, 1001), the length becoming more equal to the width.

9th sternite (spiculum gastrale): The spiculum gastrale usually is approximately ½ to ¾ the length of the aedeagus. It often is broadly curved and relatively narrow (Figs. 985, 990, 999, 1005), though it may be more straight (Figs. 1007, 1008, 1023) or have an angled apex (Figs. 990, 1001, 1004, 1019), and may

also be slightly wider (Figs. 1000, 1022). The apex may be subequal in width to the remainder, but more often is flattened and expanded (Figs. 990, 991, 1009, 1022).

Aedeagus: The median lobe may be short in length (Figs. 991, 992, 994, 1011, 1013) to long (Figs. 986, 989, 998, 1007, 1009, 1015), with lateral margins straight and parallel-sided (Figs. 986, 987, 1008, 1030), even and sinusoidal (Figs. 1001, 1020, 1022), or broadly curved (Figs. 988, 994, 999, 1012, 1019). The median lobe may also be relatively wide (usually also short in length) (Figs. 992, 996, 1000) or narrow (usually also elongate) (Figs. 986, 998, 1023, 1025). The apex may range from acutely lobed (Figs. 989, 1004, 1007), lobed with a central projection (Figs. 993, 1009, 1032), broadly curved (Figs. 985, 991, 999, 1021), or concave (Figs. 986, 992, 996, 1020). The apex may also have a wide margin, in which the median orifice is more posterior (Figs. 988, 1005, 1008, 1011), or the apical margin may be narrow, in which the median orifice is adjacent to the apex (Figs. 986, 992, 1001, 1010, 1019, 1021). Pairs of setal tufts may also be present at the apex (Figs. 987, 1014, 1023). The median orifice varies in Baridinae from being open to closed. When the median orifice is open it may be widely open, with thin lateral margins of the median lobe, as viewed dorsally (Figs. 986, 993, 996, 1002, 1021), more narrowly open, where the lateral margins of the median lobe are wider (Figs. 987, 988, 1004, 1007, 1012), or may be strictly narrow, in which the margins of the median lobe nearly fuse medially, as viewed dorsally (Figs. 989, 1022). When the lateral margins of the median lobe are completely fused, the median orifice is closed (Figs. 991, 999, 1008, 1009). Internally there often is an elongate, thin, sclerotized flagellum (Figs. 993, 1011,

1014, 1016, 1022, 1024), along with other sclerotizations (Figs. 990, 999, 1000, 1028). The median struts vary tremendously between some genera, where they may be highly reduced (Figs. 990, 998, 1014, 1024), approximately subequal in length to the median lobe (Figs. 987-989, 1002-1009), slightly longer than the median lobe (Figs. 1016, 1017, 1019, 1029), or several times longer than the median lobe (Figs. 995, 1011-1013, 1018, 1020).

Tegmen: The tegmen normally is complete and encircles the aedeagus, but it can be incomplete. The ventral tegminal strut typically is simple and relatively long, or higly elongate in some cases (Figs. 985, 988, 995, 1005, 1008, 1018, 1027). In some taxa it may be reduced in length to short stub (Figs. 990, 999), and rarely is it bifurcate. The dorsal (lateral) lobes are always elongate.

Female genitalia (Figs. 983, 984, 1044-1058)

In Baridinae, the 8th sternite of the female forms two general types: one in which the lateral basal margins (where the sternite divides) are rounded (Figs. 1045, 1047, 1048, 1056) and the second in which the lateral basal margins are angular (Figs. 1044, 1046, 1049, 1052, 1057). This basal region normally is distinctly divided (Figs. 1046, 1047, 1053), although it may become more narrowly divided (Figs. 1045, 1048) or fused (Figs. 1050, 1055, 1058). The spiculum typically is relatively short, but may be more elongate (Figs. 1045, 1048, 1058). The coxites also can be quite variable in length, often moderately short (Figs. 1044, 1054, 1057) but

also elongate in some taxa (Figs. 1046, 1048, 1055). The stylus is fairly conserved in shape, typically elongate and cylindrical.

The spermatheca possess an elongate and curved cornu, which often does not vary much in shape but may become shorter or longer and vary in curvature. The collum also does not vary

much, usually forming a small lobe. More variable, however, is the size and length of the ramus, which may be absent (Figs. 1048, 1051, 1053, 1054), form a similar sized lobe as the collum (Figs. 1046, 1052, 1058), or form an elongated extension, sometimes similar in length to the cornu (Fig. 1055).

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Appendix I: Taxa examined.

Bagoinae
Bagous transversus

Cossoninae
Cossonus impressifrons

Curculioninae
Curculio pardalis

Scolytinae
Hylurgops planirostris

Orobitidinae
Parorobitis gibbus

Conoderinae
Arachnopus gazella
Cyllophorus fausciatus
Metialma straminea
Balanogastris kolae
Telephae oculata
Cylindrocopturus adspersus
Cylindrocopturus operculatus

Acoptus suturalis
Lobotrachelus troglodytes
Mecopus trilineatus
Trichodocerus sp.

Molytinae
Cholus rana
Conotrachelus fissunguis

Trigonocolini:
Trigonocolus curvipes

Entiminae
Cyrtepistomus castanaeus

Derelominae
Derelomus basalis

Dryophthorinae
Dryophthorus americanus

Cryptorhynchinae
Cryptorhynchus lapathi

Ceutorhynchinae
Ceutorhynchus obstrictus
Hypurus bertrandi
Phytobius oriseomicans
Mononychus vulpeculus
Auleutes argentinensis
Coeliodes flavicaudis

Baridinae
Acentrinops brevicollis
Allomegops sp.
Amercedes subulirostris
Amercedes orthorrhinus
Anatorcus densus
Anavallius ruficornis
Andiblis seriata
Aniops sculpturata
Aniops sp.
Anopsilus oblongus
Anotesiops obidosensis

Antesis sparsa
Athesapeuta vinculata
Barilepsis griseus
Barilepton filiforme
Barilepton quadrieolle
Barinus bivittatus
Barinus cribricollis
Baris torquata
Barycerus collaris
Barymerus binaries
Bondariella mimica
Buchananius striatus
Buchananius sulcatus
Busckiella lecythidis
Calandrinus grandicollis
Calorida binocularis
Camelodes leachii
Camerones semiopacus
Catapastinus caseyi
Catapastus conspersus
Catapastus squamirostris
Catapastus albonotatus
Catapastus diffusus
Catapastus seriatus
Catapastus signatipennis
Catapastus simplex
Centrinites strigicollis
Centrinogyna hispidula
Centrinogyna strigata
Centrinopsis sp.
Centrinopus alternatus
Centrinopus helvinus
Centrinus curvirostris
Chepagra rotundicollis
Clandius cephalotes
Coelonertus nigrirostris
Coleomerus boliviensis
Coluthus cribrarius
Conoproctus quadripustulatus
Cosmobaris americana
Craptus tibialis
Crostidia tenuipes
Crostis subexplanata
Crotanius trivittatus

Cryptosternum nevermanni
Cylindridia prolixa
Cylindrocerus comma
Cymatobaris impressifrons
Cyrionyx camelus
Dactylocrepis flabellitarsis
Dalcesia sp.
Dealia carbonarius
Deipyle induta
Deipyrus hirsutulus
Demoda vittata
Dericinus habilis
Desmoglyptus arizonicus
Dialomia gradata
Diastethus eurthinoides
Dimesus rubricatus
Diorymeropsis disjuncta
Diorymeropsis xanthoxyli
Diorymerus lancifer
Dirabius calvus
Dirabius rectirostris
Dissopygus metallescens
Eisonyx crassipes
Eisonyx opaca
Elasmobaris signifer
Embates chaetopus
Ethelda Squamosa
Eucalus vitticolis
Eudialomia longula
Eugeraeus sp.
Eumycterus albosquamulatus
Eurhinus festivus
Eurhinus aeneus
Eusomenes curtirostris
Eutoxus sp.
Fishonia brevinasus
Forandia duplex
Forandiopsis carinulata
Fryella mutilatus
Garnia sp.
Geraeopsis duplocincta
Geraeus lineellus
Geraeus penicella
Glyptobaris lecontei

Haplostethops ellipsoidea
Hiotus inflatus
Idiostethus subcalvus
Idiostethus tubulatus
Iops bicolor
Iopsidaspis truncatula
Ladustaspis crocopelmus
Lampobaris cicullata
Lasiobaris geminata
Laurentius bruchi
Lepidobaris acnisti
Leptogarnia polita
Leptoladustes densus
Leptoschoinus fucatus
Lichnus longulus
Limnobaris bicincta
Limnobaris calandriformis
Linogarnia suturalis
Linogeraeus urbanus
Linogeraeus viduatus
Linomadarus vorticosus
Lipancylus brevirostris
Loboderes citriventris
Lorena simulans
Lydamis cinnamomeus
Macrobaris sp.
Macrorevena atromicans
Madarellus laticollis
Madarus bistrigellus
Madopterus talpa
Megabaris quadriguttata
Megalobaris viridana
Megavallius auritarsis
Melampius basalis
Microbaridia delicatula
Microcholus puncticollis
Microcholus striatus
Microforandia uniformis
Microrhinus mutilus
Microstegotes sp.
Microstrates cocois
Microtorcus tubulatus
Microzalestes basalis
Montella rufipes

Moreobaris deplanata
Myctides imberbis
Nanobaris sp.
Nedestes sarpedon
Neplaxa illustris
Nertinus suturalis
Nestrada compacta
Nicentridia angusticollis
Nicentrus decipiens
Nicentrus grossulus
Odontobaris sp.
Odontocorynus scutellumalbum
Odontocorynus creperus
Oligolochus bracatus
Oligolochus ornatus
Onychobaris densa
Oomorphidius leavicollis
Opertes sp.
Opseobaris alba
Optatus palmaris
Orchidophilus aterrimus
Orissus meigenii
Orissus christophori
Orthoris crotchii
Ortycus cristosus
Ortycus setifer
Ovanius picipennis
Ovanius minutus
Pachybaris porosa
Pachygeraeus laevirostris
Pacomes distortus
Pacomes subglaber
Palmelampius heinrichi
Palmocentrinus butia
Palocopsis tecta
Pantoteles tenuirostris
Parafishonia setulosa
Parageraeus tumidirostris
Parallelosomus amplitarsis
Parasaldius sp.
Parasomenes curvirostris
Pardisomus biplagiatus
Parisoschoenus sp.
Peclavia hispidicollis

Peclaviopsis planipectus
Peridinetus cretaceous
Peridinetus irroratus
Phacelobarus signubaris
Pistus galeatus
Platyonyx ornatus
Plesiobaris albilata
Plocamus echidna
Plocamus clavisetes
Prodinus sp.
Pseudobaris angusta
Pseudocentrinus ochraceus
Pseudogeraeus macropterus
Pseudorancea spissirostris
Pseudorthoris devexus
Pseudosaldius conjunctus
Pseudotorcus rufipes
Psiona densa
Pteracanthus smidtii
Pycnobaris pruinosa
Pycnogeraeus modestus
Pycnogeraeus striatirostris
Pycnonicentrus gilvivestis
Pycnotheantis sp.
Rancea parviclava
Ranceoma uniformis
Remertus marginatus
Ravena sexualis
Reveniopsis sp.
Rhoptobaris canescens
Rhytidoglymma cenescens
Roalius rufipes
Saldiopsis armata
Saldius inaequalis
Scirpicola chilensis
Selasella cuneipennis
Sibariops concinna
Sibariops concurrens
Sibariopsida docilis
Sodesia sparsa
Solaria curtula
Solenosternus dividuus
Somenes regestus
Sphenobaris quadridens

Spolatia gradata
Starcus rugulosus
Stereobaris interpunctata
Stethobaris commixta
Stethobaris laevimargo
Stethobaroides nudiventris
Stictobaris cribrata
Strongylotes squamans
Sunilius platyrhinhus
Telemus sp.
Tenemotes abdominalis
Tenemotes parviclava
Ternova biartita
Testalthea sp.
Thaliabaris inermis
Thanius sp.
Thestonia sparsa
Tonesia sp.
Torcobius sp.
Torcus nigrinus
Torcus variabilis
Trachymeropsis palmipes
Trepobaris inornata
Trichobaris texana
Trichodirabius longulus
Ulobaris loricata
Valdenus laevis
Valiopsis squamipes
Vallius sulcatus
Xystus ater
Xystus ruficollis
Zalestes perpolitus
Zathanius sp.
Zena virgata
Zygobarella xanthoxyli
Zygobarella tristicula
Zygobarinus coelestinus
Zygobaris sp. 1
Zygobaris nitens
Zygobaris sp.
Zygozalestes oblongus
"Neomadarini"

Figure captions

Figs. 1-11. Adults, lateral view. 1, *Amercedes subulirostris*; 2, *Baris torquata*; 3, *Centrinus curvirostris*; 4, *Barymerus binarius*; 5, *Conoproctus quadripustulatus*; 6, *Cylindrocerus comma*; 7, *Cyrionyx camelus*; 8, *Demoda vittata*; 9, *Diastethus eurthinoides*; 10, *Diorymerus lancifer*; 11, *Embates chaetopus*.

Figs. 12-22. Adults, lateral view. 12, *Eurhinus festivus*; 13, *Eurhinus festivus*; 14, *Fryella mutilatus*; 15, *Geraeus lineellus*; 16, *Lepidobaris acnisti*; 17, *Loboderes citriventris*; 18, *Madarellus laticollis*; 19, *Megabaris quadriguttata*; 20, *Microstrates cocois*; 21, *Optatus palmaris*; 22, *Pacomes subglaber*.

Figs. 23-34. Adults, lateral view. 23, *Palmelampius heinrichi*; 24, *Pardisomus biplagiatus*; 25, *Peridinetus suturalis*; 26, *Phacelobarus signubaris*; 27, *Pistus galeatus*; 28, *Plocamus echidna*; 29, *Pteracanthus smidtii*; 30, *Remertus marginatus*; 31, *Reveniopsis* sp.; 32, *Rhytidoglymma cenescens*; 33, *Telemus* sp.; 34, *Zygobarinus coelestinus*.

Figs. 35-43. Adults, lateral view. 35, *Allomegops* sp.; 36, *Cymatobaris impressifrons*; 37, *Hiotus inflatus*; 38, *Megalobaris viridana*; 39, *Ortycus setifer*; 40, *Testalthea* sp.; 41, *Tonesia* sp.; 42, *Trichobaris texana*; 43, *Arachnopus gazella*.

Figs. 44-48. Adults, lateral view. 44, *Balanogastris kolae*; 45, *Cyllophorus fausciatus*; 46, *Telephae oculata*; 47, *Trichodocerus* sp.; 48, *Trigonocolus curvipes*.

Figs. 49-59. Adults, dorsal view. 49, *Amercedes subulirostris*; 50, *Baris torquata*; 51, *Centrinus curvirostris*; 52, *Barymerus binarius*; 53, *Conoproctus quadripustulatus*; 54, *Cylindrocerus comma*; 55, *Cyrionyx camelus*; 56, *Demoda vittata*; 57, *Diastethus eurthinoides*; 58, *Diorymerus lancifer*; 59, *Embates chaetopus*.

Figs. 60-70. Adults, dorsal view. 60, *Eurhinus festivus*; 61, *Eurhinus festivus*; 62, *Fryella mutilatus*; 63, *Geraeus lineellus*; 64, *Lepidobaris acnisti*; 65, *Loboderes citriventris*; 66, *Madarellus laticollis*; 67, *Megabaris quadriguttata*; 68, *Microstrates cocois*; 69, *Optatus palmaris*; 70, *Pacomes subglaber*.

Figs. 71-82. Adults, dorsal view. 71, *Palmelampius heinrichi*; 72, *Pardisomus biplagiatus*; 73, *Peridinetus suturalis*; 74, *Phacelobarus signubaris*; 75, *Pistus galeatus*; 76, *Plocamus echidna*; 77, *Pteracanthus smidtii*; 78, *Remertus marginatus*; 79, *Reveniopsis* sp.; 80, *Rhytidoglymma cenescens*; 81, *Telemus* sp.; 82, *Zygobarinus coelestinus*.

Figs. 83-94. Adults, dorsal view. 83, *Allomegops* sp.; 84, *Cymatobaris impressifrons*; 85, *Hiotus inflatus*; 86, *Megalobaris viridana*; 87, *Ortycus setifer*; 88, *Testalthea* sp.; 89, *Tonesia* sp.; 90, *Trichobaris texana*; 91, *Arachnopus gazella*; 92, *Balanogastris kolae*; 93, *Cyllophorus fausciatus*; 94, *Telephae oculata*.

Figs. 95-96. Adults, dorsal view. 95, *Trichodocerus* sp.; 96, *Trigonocolus curvipes*.

Figs. 97-109. Adult morphology. 97, *Dialomia gradata* (dorsal view); 98, *Orissus christophori* (dorsal view); 99, *Orissus meigenii* (lateral view); 100, *Nertinus suturalis* (lateral view); 101, *Prodinus* sp. (dorsal view); 102, *Prodinus* sp. (lateral view); 103, *Parallelosomus amplitarsis* (lateral view); 104, *Torcus nigrinus* (lateral view); 105, *Peridinetus cretaceus* (dorsal view); 106, *Barinus bivittatus* (dorsal view); 107, *Microcholus puncticollis* (dorsal view); 108, *Catapastus squamirostris* (SEM); 109, *Stethobaris laevimargo* (SEM).

Figs. 110-117. Scale morphology. 110, *Plocamus echidna* (lateral view). 111-117, SEM's. 111-112, *Pseudorthoris devexus*; 113, *Coleomerus boliviensis*; 114, *Baris torquata*; 115-116, *Geraeus lineellus*; 117, *Anthinobaris* sp.

Figs. 118-125. Scale morphology, SEM's. 118, *Spilobaris* sp.; 119-120, *Lophobaris* sp.; 121, *Limnobaris jucunda*; 122, *Pachybaris porosa*; 123, *Taiwanobaris* sp.; 124, *Pachybaris porosa*; 125, *Acythopeus* sp.

Figs. 126-131. 126, *Lixus concavus*, scale morphology. 127-131, head morphology, SEM's. 127, *Taiwanobaris* sp.; 128-131, *Anthinobaris* sp. 128, latero-ventral view; 129, lateral view; 130, enlargement of lateral view; 131, scales along margin of pronotum.

Figs. 132-141. Head and rostrum. 132, *Centrinus curvirostris*; 133, *Tenemotes abdominalis*; 134-135, *Acythophanes* sp.; 136, *Orissus christophori*; 137, *Pantoteles tenvirostris*; 138, *Peridinetus cretaceus*; 139, *Peridinetus irroratus*; 140, *Leptoschoinus fucatus*; 141, *Garnia* sp.

Figs. 142-150. Head and rostrum. 142, *Xystus ruficollis*; 143, *Odontocorynus creperus*; 144, *Eurhinus aeneus*; 145, *Diorymerus lancifer*; 146, *Spilobaris* sp.; 147, *Lamprobaris cicullata*; 148, *Telemus* sp.; 149, *Pteracanthus smidtii*; 150, *Stereobaris interpunctata*.

Figs. 151-161. Head and rostrum. 151, *Conoproctus quadripustulatus*; 152, *Trichodocerus* sp.; 153, *Hypurus bertrandi*; 154, *Cyllophorus fausciatus*; 155, *Acythophanes* sp.; 156, *Centrinogyna strigata*; 157, *Dealia carbonarius*; 158,

Fishonia brevinasus; 159, *Crotanius trivittatus*; 160, *Dactylocrepis flabellitarsis*; 161, *Myctides imberbis*.

Figs. 162-174. 162-165, head and rostrum. 162, *Zygozalestes oblongus*; 163, *Microrhinus mutilus*; 164, *Strongylotes squamans*; 165, *Pardisomus biplagiatus*. 166-174, antennae. 166, *Anavallius ruficornis*; 167-168, *Oligolochus bracatus*; 169-170, *Camelodes leachii*; 171, *Diorymerus lancifer*; 172, *Orthoris crotchii*; 173, antennae; 174, *Catapastus squamirostris*.

Figs. 175-182. Antennae. 175, *Idiostethus subcalvus*; 176, *Stethobaris laevimargo*; 177, *Pertorcus* sp.; 178, *Madarus bistrigellus*; 179-180, *Cylindrocerus comma*; 181-182, *Taiwanobaris* sp.

Figs. 183-185. Mouthparts, *Anthinobaris* sp. 183, labium; 184, maxilla; 185, mandible (right).

Figs. 186-194. Mouthparts. 186-187, *Demoda vittata*. 186, ventral aspect of apex of rostrum, showing labium, maxilla, and mandibles; 187, enlargement of apical maxillary palpal lobes; 188-189, *Cylindrocerus comma*. 188, lateral aspect of apex of rostrum; 189, enlargement of 3rd maxillary palpal lobe; 190, *Demoda vittata*, labial palpus; 191-192, *Ovanius picipennis*, left and right mandibles, respectively; 193-194, *Zygobarella xanthoxyli*, left and right mandibles, respectively.

Figs. 195-206. Mouthparts - labia. 195, *Zygobaris nitens*; 196, *Centrinus curvirostris*; 197, *Anthinobaris* sp.; 198, *Ovanius picipennis*; 199, *Nertinus suturalis*; 200, *Peridinetus irroratus*; 201, *Loboderes citriventris*; 202, *Antesis sparsa*; 203, *Acentrinops brevicollis*; 204, *Garnia* sp.; 205, *Pachygeraeus laevirostris*; 206, *Eisonyx crassipes*.

Figs. 207-220. Mouthparts – labia. 207, *Dirabius calvus*; 208, *Eisonyx opaca*; 209, *Xystus ruficollis*; 210, *Geraeus penicella*; 211, *Microcholus puncticollis*; 212, *Linogeraeus viduatus*; 213, *Ovanius minutus*; 214, *Plocamus echidna*; 215, *Oligolochus bracatus*; 216, *Oligolochus ornatus*; 217, *Odontocorynus scutellumalbum*; 218, *Odontocorynus creperus*; 219, *Camelodes leachii*; 220, *Sibariops concinna*.

Figs. 221-233. Mouthparts – labia. 221, *Sibariops concurrens*; 222, *Torcus nigrinus*; 223, *Madopterus talpa*; 224, *Parallelosomus amplitarsis*; 225, *Orchidophilus aterrimus*; 226, *Embates chaetopus*; 227, *Eurhinus festivus*; 228, *Eurhinus aeneus*; 229, *Coleomerus boliviensis*; 230, *Coelonertus nigrirostris*; 231, *Baris torquata*; 232, *Lydamis cinnamomeus*; 233, *Busckiella lecythidis*.

Figs. 234-245. Mouthparts – labia. 234, *Rhoptobaris canescens*; 235, *Parisoschoenus* sp.; 236, *Pardisomus biplagiatus*; 237, *Pycnotheantis* sp.; 238,

Telemus sp.; 239, *Pteracanthus smidtii*; 240, *Megabaris quadriguttata*; 241, *Conoproctus quadripustulatus*; 242, *Eugeraeus* sp.; 243, *Lepidobaris acnisti*; 244, *Phacelobarus signubaris*; 245, *Cyrtepistomus castanaeus*.

Figs. 246-256. Mouthparts – labia. 246, *Derelomus basalis*; 247, *Cryptorhynchus lapathi*; 248, *Bagous transversus*; 249, *Cholus rana*; 250, *Cossonus impressifrons*; 251, *Curculio pardalis*; 252, *Hylurgops planirostris*; 253, *Barycerus collaris*; 254, *Testalthea* sp.; 255, *Rhytidoglymma cenescens*; 256, *Megalobaris viridana*.

Figs. 257-269. Mouthparts – labia. 257, *Barymerus binarius*; 258, *Trichodocerus* sp.; 259, *Coeliodes flavicaudis*; 260, *Mononycus vulpeculus*; 261, *Hypurus bertrandi*; 262, *Trigonocolus curvipes*; 263, *Mecopus trilineatus*; 264, *Cylindrocopturus adspersus*; 265, *Telephae oculata*; 266, *Balanogastris kolae*; 267, *Metialma straminea*; 268, *Cyllophorus fausciatus*; 269, *Arachnopus gazella*.

Figs. 270-278. Mouthparts - maxilla. 270, *Zygobaris nitens*; 271, *Centrinus curvirostris*; 272, *Anthinobaris* sp.; 273, *Ovanius picipennis*; 274, *Nertinus suturalis*; 275, *Peridinetus irroratus*; 276, *Antesis sparsa*; 277, *Loboderes citriventris*; 278, *Loboderes citriventris*.

Figs. 279-288. Mouthparts - maxilla. 279, *Antesis sparsa*; 280, *Acentrinops brevicollis*; 281, *Garnia* sp.; 282, *Pachygeraeus laevirostris*; 283, *Eisonyx crassipes*;

284, *Dirabius calvus*; 285, *Eisonyx opaca*; 286, *Xystus ruficollis*; 287, *Buchananius sulcatus* (maxilla-labium complex); 288, *Geraeus penicella*.

Figs. 289-298. Mouthparts - maxilla. 289, *Microcholus puncticollis*; 290, *Linogeraeus viduatus*; 291, *Ovanius minutus*; 292, *Plocamus echidna*; 293, *Plocamus clavisetes*; 294, *Oligolochus bracatus*; 295, *Oligolochus ornatus*; 296, *Odontocorynus scutellumalbum*; 297, *Odontocorynus creperus*; 298, *Camelodes leachii*.

Figs. 299-308. Mouthparts - maxilla. 299, *Sibariops concinna*; 300, *Sibariops concurrens*; 301, *Torcus nigrinus*; 302, *Madopterus talpa*; 303, *Parallelosomus amplitarsis*; 304, *Orchidophilus aterrimus*; 305, *Embates chaetopus*; 306, *Eurhinus festivus*; 307, *Eurhinus aeneus*; 308, *Coleomerus boliviensis*.

Figs. 309-317. Mouthparts - maxilla. 309, *Coelonertus nigrirostris*; 310, *Baris torquata*; 311, *Cyrionyx camelus*; 312, *Lydamis cinnamomeus*; 313, *Busckiella lecythidis*; 314, *Rhoptobaris canescens*; 315, *Plesiobaris albilata*; 316, *Parisoschoenus* sp.; 317, *Pardisomus biplagiatus*.

Figs. 318-325. Mouthparts - maxilla. 318, *Pycnotheantis* sp.; 319, *Telemus* sp.; 320, *Pteracanthus smidtii*; 321, *Megabaris quadriguttata*; 322, *Conoproctus quadripustulatus*; 323, *Eugeraeus* sp.; 324, *Lepidobaris acnisti*; 325, *Phacelobarus signubaris*.

Figs. 326-335. Mouthparts - maxilla. 326, *Cyrtepistomus castanaeus*; 327, *Derelomus basalis*; 328, *Cryptorhynchus lapathi*; 329, *Cholus rana*; 330, *Dryophthorus americanus* (Dryophthorinae); 331, *Bagous transversus*; 332, *Cossonus impressifrons*; 333, *Curculio pardalis*; 334, *Hylurgops planirostris*; 335, *Barycerus collaris*.

Figs. 336-344. Mouthparts - maxilla. 336, *Testalthea* sp.; 337, *Rhytidoglymma cenescens*; 338, *Megalobaris viridana*; 339, *Barymerus binarius*; 340, *Trichodocerus* sp.; 341, *Coeliodes flavicaudis*; 342, *Mononychus vulpeculus*; 343, *Hypurus bertrandi*; 344, *Trigonocolus curvipes*.

Figs. 345-352. Mouthparts - maxilla. 345, *Trigonocolus curvipes*; 346, *Mecopus trilineatus*; 347, *Cyllophorus fausciatus*; 348, *Cylindrocopturus adspersus*; 349, *Telephae oculata*; 350, *Balanogastris kolae*; 351, *Metialma straminea*; 352, *Arachnopus gazella*.

Figs. 353-367. Mouthparts - mandibles. 353, *Zygobaris nitens*; 354, *Centrinus curvirostris*; 355, *Anthinobaris* sp.; 356, *Ovanius picipennis*; 357, *Peridinetus irroratus*; 358, *Loboderes citriventris*; 359, *Antesis sparsa*; 360, *Acentrinops brevicollis*; 361, *Garnia* sp.; 362, *Pachygeraeus laevirostris*; 363, *Eisonyx crassipes*;

364, *Dirabius calvus*; 365, *Eisonyx opaca*; 366, *Xystus ruficollis*; 367, *Buchananius sulcatus*.

Figs. 368-384. Mouthparts - mandibles. 368, *Geraeus penicella*; 369, *Microcholus puncticollis*; 370, *Linogeraeus viduatus*; 371, *Ovanius minutus*; 372, *Plocamus echidna*; 373, *Plocamus calvisetes*; 374, *Oligolochus bracatus*; 375, *Oligolochus ornatus*; 376, *Odontocorynus scutellumalbum*; 377, *Odontocorynus creperus*; 378, *Camelodes leachii*; 379, *Sibariops concinna*; 380, *Torcus nigrinus*; 381, *Sibariops concurrens*; 382, *Madopterus talpa*; 383, *Parallelosomus amplitarsis*; 384, *Orchidophilus aterrimus*.

Figs. 385-400. Mouthparts - mandibles. 385, *Embates chaetopus*; 386, *Eurhinus festivus*; 387, *Eurhinus aeneus*; 388, *Coleomerus boliviensis*; 389, *Coelonertus nigrirostris*; 390, *Baris torquata*; 391, *Cyrionyx camelus*; 392, *Lydamis cinnamomeus*; 393, *Busckiella lecythidis*; 394, *Rhoptobaris canescens*; 395, *Plesiobaris albilata*; 396, *Parisoschoenus* sp.; 397, *Pardisomus biplagiatus*; 398, *Pycnotheantis* sp.; 399, *Telemus* sp.; 400, *Pteracanthus smidtii*.

Figs. 401-415. Mouthparts - mandibles. 401, *Megabaris quadriguttata*; 402, *Conoproctus quadripustulatus*; 403, *Eugeraeus* sp.; 404, *Lepidobaris acnisti*; 405, *Phacelobarus signubaris*; 406, *Cyrtepistomus castanaeus*; 407, *Derelomus basalis*; 408, *Cryptorhynchus lapathi*; 409, *Dryophthorus americanus*; 410, *Bagous*

transversus; 411, *Cholus rana*; 412, *Cossonus impressifrons*; 413, *Curculio pardalis*; 414, *Hylurgops planirostris*; 415, *Barycerus collaris*.

Figs. 416-431. Mouthparts - mandibles. 416, *Testalthea* sp.; 417, *Rhytidoglymma cenescens*; 418, *Megalobaris viridana*; 419, *Barymerus binarius*; 420, *Trichodocerus* sp.; 421, *Coeliodes flavicaudis*; 422, *Mononychus vulpeculus*; 423, *Mecopus trilineatus*; 424, *Hypurus bertrandi*; 425, *Trigonocolus curvipes*; 426, *Cylindrocopturus adspersus*; 427, *Telephae oculata*; 428, *Balanogastris kolae*; 429, *Metialma straminea*; 430, *Cyllophorus fausciatus*; 431, *Arachnopus gazella*.

Figs. 432-450. 432-434, tendons of mouthparts. 432, tendons on maxilla; 433-434, tendons on mandible. 435-450, proventriculus. 435, *Optatus palmaris*; 436, *Peridinetus irroratus*; 437, *Garnia* sp.; 438, *Eisonyx crassipes*; 439, *Xystus ruficollis*; 440, *Camelodes leachii*; 441, *Diorymerus lancifer*; 442, *Centrinopus alternatus*; 443, *Anavallius ruficornis*; 444, *Telemus* sp.; 445, *Conoproctus quadripustulatus*. 446-447, *Cyrtepistomus castanaeus*. 446, lateral view; 447, anterior view; 448, *Bagous transversus*; 449, *Cholus rana*; 450, *Hylurgops planirostris*.

Figs. 451-459. Internal organs. 451, *Trigonocolus curvipes* (proventriculus). 452-453, *Pycnogeraeus striatirostris*. 452, proventriculus; 453, mesenteron and proctodeum. 454-459, *Acythopeus* sp. 454, divisions of gut (ventral view); 455,

lateral view (left side); 456, dorsal view; 457, lateral view (right side); 458, enlargement of anterior ganglia; 459, enlargement of stomodeum.

Figs. 460-467. SEM images of Pronotum. 460, *Taiwanobaris* sp.; 461, *Centrinogyna strigata*; 462, *Catapastus squamirostris*; 463, *Trichodirabius longulus*; 464, *Pycnogeraeus modestus*; 465, *Centrinogyna strigata*; 466, *Pertorcus* sp.; 467, *Odontocorynus creperus*.

Figs. 468-475. SEM images of Pronotum. 468, *Conotrachelus fissunguis* (Molytinae) (lateral view); 469, *Pertorcus* sp. (lateral view); 470, *Pseudocentrinus ochraceus*, lateral view of puncture collar; 471, *Centrinopus helvinus*, lateral view of puncture collar; 472, enlargement of puncture collar of 471; 473, *Pachybaris porosa*, lateral view; 474, *Microstegotes sp.* (lateral view); 475, *Vallius sulcatus* (lateral view).

Figs. 476-482. SEM images of pronotum. 476-479, *Idiostethus tubulatus*. 476, lateral view; 477, scales along latero-posterior margin; 478, scales along posterior margin; 479, enlargement of 478. 480-482, *Geraeus lineellus*. 480, scales along posterior margins; 481, scales along lateral margin; 482, enlargement of 480.

Figs. 483-495. 483-485, pro-sternum. 483, *Parallelosomus amplitarsis*; 484, *Embates chaetopus*; 485, *Zygobaris nitens*. 486-495, pro-sternal process. 486,

Barinus bivittatus; 487, *Eisonyx opaca*; 488, *Embates chaetopus*; 489, *Geraeus penicella*; 490, *Limnobaris calandriformis*; 491, *Loboderes citriventris*; 492, *Megavallius auritarsis*; 493, *Madopterus talpa*; 494, *Nertinus suteralis*; 495, *Nicentrus grossulus*.

Figs. 496-500. Pro-sternal process. 496, *Parallelosomus amplitarsis*; 497, *Odontocorynus scutellumalbum*; 498, *Peridinetus cretaceus*; 499, *Xystus ater*; 500, *Xystus ruficollis*.

Figs. 501-510. Prosternal horns. 501-506, horn sheath. 501, *Demoda vittata*; 502, *Orissus christophori*; 503-504, *Orissus meigenii*. 503, lateral view; 504, posterior view; 505, *Pseudotorcus rufipes*; 506, *Anavallius ruficornis*. 507-510, SEM's. 507, *Centrinopus alternatus*; 508, *Pycnogeraeus modestus*; 509, *Geraeus lineellus*; 510, *Demoda vittata*.

Figs. 511-513. Thoracic structures. 511, *Orissus meigenii*, mesonotum; 512, *Leptoschoinus fucatus*, metanotum; 513, *Stereobaris interpunctata*, metendosternite.

Figs. 514-537. Meso-notum. 514, *Centrinus curvirostris*; 515, *Tenemotes abdominalis*; 516, *Demoda vittata*; 517, *Acythophanes* sp.; 518, *Pycnogeraeus modestus*; 519, *Stethobaroides nudiventris*; 520, *Pycnogeraeus ochraceus*; 521, *Orissus christophori*; 522, *Orissus meigenii*; 523, *Pantoteles tenvirostris*; 524,

Optatus palmaris; 525, *Peridinetus cretaceus*; 526, *Strongylotes squamans*; 527, *Nertinus suturalis*; 528, *Peridinetus irroratus*; 529, *Leptoschoinus fucatus*; 530, *Barilepton filiforme*; 531, *Garnia* sp.; 532, *Eisonyx crassipes*; 533, *Dirabius calvus*; 534, *Xystus ruficollis*; 535, *Parasomenes curvirostris*; 536, *Plocamus echidna*; 537, *Odontocorynus creperus*.

Figs. 538-561. Meso-notum. 538, *Calandrinus grandicollis*; 539, *Camelodes leachii*; 540, *Pseudotorcus rufipes*; 541, *Madopterus talpa*; 542, *Lipancylus brevirostris*; 543, *Eurhinus aeneus*; 544, *Diorymerus lancifer*; 545, *Spilobaris* sp.; 546, *Acythopeus* sp.; 547, *Zena* sp.; 548, *Orthoris crotchii*; 549, *Lamprobaris cicullata*; 550, *Pseudogeraeus macropterus*; 551, *Anavallius ruficornis*; 552, *Solenosternus dividuus*; 553, *Telemus* sp.; 554, *Pteracanthus smidtii*; 555, *Stereobaris interpunctata*; 556, *Conoproctus quadripustulatus*; 557, *Athesapeuta vinculata*; 558, *Cyrtepistomus castanaeus*; 559, *Derelomus basalis*; 560, *Cryptorhynchus lapathi*; 561, *Dryophthorus americana*.

Figs. 562-577. Meso-notum. 562, *Bagous transversus*; 563, *Cossonus impressifrons*; 564, *Curculio pardalis*; 565, *Hylurgops planirostris*; 566, *Trichodocerus* sp.; 567, *Coeliodes flavicaudis*; 568, *Mononychus vulpeculus*; 569, *Hypurus bertrandi*; 570, *Trigonocolus curvipes*; 571, *Mecopus trilineatus*; 572, *Cylindrocopterus adspersus*; 573, *Telephae oculata*; 574, *Balanogastris kolae*; 575, *Metialma straminea*; 576, *Cyllophorus fausciatus*; 577, *Parorobitis.gibbus*.

Figs. 578-587. Thorax. 578, thorax, lateral view. 579-581, SEM's of meso- and meta-notum. 579, *Sibariops concurrens*; 580, *Geraeus lineellus*; 581, *Demoda vittata*. 582-587, SEM's of meso-scutellum. 582, *Taiwanobaris* sp.; 583, *Lophobaris* sp.; 584, *Zygobarella zanthoxyli*; 585, *Idiostethus subcalvus*; 586, *Idiostethus tubulatus*; 587, *Deipyrus hirsutulus*.

Figs. 588-600. SEM's of meso-scutellum. 588, *Trichodirabius longulus*; 589, *Cylindridia prolixa*; 590, *Stethobaris laevimargo*; 591, *Pycnogeraeus modestus*; 592, *Stethobaris commixta*; 593, *Stethobaroides nudiventris*; 594, *Baris* sp.; 595, *Baris* sp.; 596, *Pertorcus* sp.; 597, *Pseudorthoris devexus*; 598, *Pycnogeraeus striatirostris*; 599, *Pseudocentrinus ochraceus*; 600, *Pachybaris porosa*.

Figs. 601-611. Elytra. 601, *Demoda vittata*; 602, *Orissus christophori*; 603, *Garnia* sp.; 604, *Madopterus talpa*; 605, *Telemus* sp.; 606, *Anthinobaris* sp.; 607, *Catapastus signatipennis*; 608, *Centrinopus alternatus*; 609-611, *Anthinobaris* sp.

Figs. 612-618. Elytra, SEM's. 612, *Catapastus signatipennis*; 613-614, *Anthinobaris* sp.; 615-616, *Anthinobaris* sp.; 617-618, *Lophobaris* sp.

Figs. 619-626. Elytra. 619-621, *Anthinobaris* sp., setae along intervals and associated pores; 622, *Anthinobaris* sp.; 623, *Anthinobaris* sp.; 624, *Anthinobaris* sp.; 625, *Anthinobaris* sp.; 626, *Anthinobaris* sp.

Figs. 627-632. Elytra. 627-628, *Baris* sp.; 629, *Zygobaris* sp., elytral suture; 630, *Diorymeropsis disjuncta*, ventral view; 631, *Diorymeropsis disjuncta*, lateral margin (ventral view); 632, *Pertorcus* sp., elytral apex (ventral view).

Figs. 633-640. Elytra. 633, *Pertorcus* sp.; 634-635, *Acythopeus* sp.; 636-637, *Stethobaris commixta*; 638-640, *Stethobaris laevimargo*.

Figs. 641-648. Elytra. 641-642, *Stethobaris laevimargo*; 643-644, *Stethobaroides nudiventris*; 645-646, *Pycnogeraeus striatirostris*; 647-648, *Pseudocentrinus ochraceus*.

Figs. 649-654. Elytra. 649-650, *Pachybaris porosa*; 651, *Spilobaris* sp.; 652, *Spilobaris* sp., medial humeral angle (ventral view); 653, *Embates chaetopus*, elytral apex; 654, *Loboderes citriventris*, elytral apex.

Figs. 655-672. Metanota (dorsal view). 655, *Centrinus curvirostris*; 656, *Tenemotes abdominalis*; 657, *Demoda vittata*; 658, *Acythophanes* sp.; 659, *Pycnogeraeus modestus*; 660, *Stethobaroides nudiventris*; 661, *Pycnogeraeus ochraceus*; 662,

Orissus christophori; 663, *Orissus meigenii*; 664, *Pantoteles tenvirostris*; 665, *Optatus palmaris*; 666, *Strongylotes squamans*; 667, *Nertinus suturalis*; 668, *Peridinetus irroratus*; 669, *Leptoschoinus fucatus*; 670, *Barilepton filiforme*; 671, *Garnia* sp.; 672, *Eisonyx crassipes*.

Figs. 673-690. Metanota (dorsal view). 673, *Dirabius calvus*; 674, *Xystus ruficollis*; 675, *Parasomenes curvirostris*; 676, *Plocamus echidna*; 677, *Odontocorynus creperus*; 678, *Camelodes leachii*; 679, *Pseudotorcus rufipes*; 680, *Madopterus talpa*; 681, *Lipancylus brevirostris*; 682, *Eurhinus aeneus*; 683, *Diorymerus lancifer*; 684, *Spilobaris* sp.; 685, *Acythopeus* sp.; 686, *Zena* sp.; 687, *Orthoris crotchii*; 688, *Lamprobaris cicullata*; 689, *Pseudogeraeus macropterus*; 690, *Anavallius ruficornis*.

Figs. 691-708. Metanota (dorsal view). 691, *Solenosternus dividuus*; 692, *Telemus* sp.; 693, *Pteracanthus smidtii*; 694, *Stereobaris interpunctata*; 695, *Conoproctus quadripustulatus*; 696, *Athesapeuta vinculata*; 697, *Cyrtepistomus castanaeus*; 698, *Derelomus basalis*; 699, *Cryptorhynchus lapathi*; 700, *Dryophthorus americanus*; 701, *Bagous transversus*; 702, *Cossonus impressifrons*; 703, *Curculio pardalis*; 704, *Hylurgops planirostris*; 705, *Trichodocerus* sp.; 706, *Coeliodes flavicaudis*; 707, *Mononychus vulpeculus*; 708, *Hypurus bertrandi*.

Figs. 709-716. Metanota (dorsal view). 709, *Trigonocolus curvipes*; 710, *Mecopus trilineatus*; 711, *Cylindrocopterus adspersus*; 712, *Telephae oculata*; 713,

Balanogastris kolae; 714, *Metialma straminea*; 715, *Cyllophorus fausciatus*; 716, *Parorobitis gibbus*.

Figs. 717-734. Metendosternite, posterior view. 717, *Centrinus curvirostris*; 718, *Pycnogeraeus modestus*; 719, *Stethobaroides nudiventris*; 720-721, *Orissus christophori*; 721, dorsal view; 722, *Pantoteles tenvirostris*; 723, *Optatus palmaris*; 724, *Peridinetus cretaceus*; 725, *Nertinus suturalis*; 726, *Peridinetus irroratus*; 727, *Leptoschoinus fucatus*; 728, *Garnia* sp.; 729, *Dirabius calvus*; 730, *Parasomenes curvirostris*; 731, *Plocamus echidna*; 732, *Odontocorynus creperus*; 733, *Calandrinus grandicollis*; 734, *Camelodes leachii*.

Figs. 735-752. Metendosternite, posterior view. 735, *Pseudotorcus rufipes*; 736, *Madopterus talpa*; 737, *Lipancylus brevirostris*; 738, *Eurhinus aeneus*; 739, *Diorymerus lancifer*; 740, *Spilobaris* sp.; 741, *Acythopeus* sp.; 742, *Zena* sp.; 743, *Orthoris crotchii*; 744, *Pseudogeraeus macropterus*; 745, *Anavallius ruficornis*; 746, *Solenosternus dividuus*; 747, *Pardisomus biplagiatus*; 748, *Telemus* sp.; 749, *Pteracanthus smidtii*; 750, *Stereobaris interpunctata*; 751, *Athesapeuta vinculata*; 752, *Cyrtepistomus castanaeus*.

Figs. 753-771. Metendosternite, posterior view. 753, *Derelomus basalis*; 754, *Cryptorhynchus lapathi*; 755, *Dryophthorus americanus*; 756, *Bagous transversus*; 757, *Cholus rana*; 758, *Cossonus impressifrons*; 759, *Curculio pardalis*; 760,

Hylurgops planirostris; 761, *Trichodocerus* sp.; 762, *Coeliodes flavicaudis*; 763, *Mononychus vulpeculus*; 764, *Hypurus bertrandi*; 765, *Trigonocolus curvipes*; 766, *Mecopus trilineatus*; 767, *Cylindrocopterus adspersus*; 768, *Balanogastris kolae*; 769, *Metialma straminea*; 770, *Cyllophorus fausciatus*; 771, *Parorobitis gibbus*.

Figs. 772-779. Sclerolepidia. 772-773, *Megavallius auritarsis*; 774-775, *Pteracanthus smidtii* (dorso-lateral view); 776-777, *Amercedes subulirostris*; 778, *Zygobarella zanthoxyli*; 779, *Pseudocentrinus ochraceus* (dorsal view).

Figs. 780-787. 780-784, sclerolepidia. 780, *Pseudocentrinus ochraceus* (dorsal view); 781-784, *Lydamis cinnamomeus*. 781-782, lateral view; 783-784, dorsal view. 785-787, thoracic wing-locking patches. 785-787, *Anthinobaris* sp.

Figs. 788-795. 788-790, thoracic wing-locking patches. 788, *Anthinobaris* sp., metascutum; 789-790, *Anthinobaris* sp. (lateral view). 791-795, elytra (ventral view). 791-792, *Amercedes orthorrhinus*; 793, *Acythophanes* sp., elytral apex; 794-795, *Lixus concavus* (Lixinae). 794, medial humeral margin; 795, lateral humeral margin.

Figs. 796-799. Hind wings, SEM's. 130-133, *Anthinobaris* sp.

Figs. 800-802. 800, *Optatus palmaris*, hind wing venation: C=Costa; Sc=Subcosta; Rr=radial recurrent vein; R=Radius; r-m=radiomedia; rms=radiomedial

sclerotization; rcm=margin of radial cell; rc=radial cell; rfi=radial fissure; 2rs, 1rs=radial sclerites; R3=3rd radial; rsc=radial sclerotization; pst=postradial stripe; mst=medial stripe; Cu_1=1st Cubital; af=apical fold of Cu_1; msc=medial sclerotization; $1A_1$, $1A_2$=1st Anal branches; Cu=Cubital; A=Anal; ac=anal cell; 3A=3rd Anal. 801, hind wing, basal sclerites: Mr=medial recurrent vein; 1Ax, 2Ax, 3Ax=Axillary sclerites; BCu=cubital basivenale; Bm=medial basivenale; Br+BSc=radial basivenale + subcostal basivenale. 802, tergites: SS=spiracular sclerite; MS=median sclerite; lt=laterotergite.

Figs. 803-814. Hind wings. 803, *Centrinus curvirostris*; 804, *Optatus palmaris*; 805, *Eutoxus* sp.; 806, *Parasaldius* sp.; 807, *Buchananius sulcatus*; 808, *Haplostethops ellipsoidea*; 809, *Linogeraeus viduatus*; 810, *Plocamus echidna*; 811, *Plocamus clavisetes*; 812, *Odontocorynus scutellumalbum*; 813, *Lipancylus brevirostris*; 814, *Orchidophilus aterrimus*.

Figs. 815-826. Hind wings. 815, *Embates chaetopus*; 816, *Diorymerus lancifer*; 817, *Cyrionyx camelus*; 818, *Solaria curtula*; 819, *Palmelampius heinrichi*; 820, *Pycnotheantis* sp.; 821, *Telemus* sp.; 822, *Megabaris quadriguttata*; 823, *Zygobaris* sp.; 824, *Trachymeropsis palmipes*; 825, *Cyrtepistomus castanaeus*; 826, *Cryptorhynchus lapathi*.

Figs. 827-840. Hind wings. 827, *Dryophthorus americanus*; 828, *Bagous transversus*; 829, *Cholus rana*; 830, *Cossonus impressifrons*; 831, *Curculio pardalis*; 832, *Hylurgops planirostris*; 833, *Testalthea* sp.; 834, *Pacomes distortus*; 835, *Trichodocerus* sp.; 836, *Coeliodes flavicaudis*; 837, *Mononychus vulpeculus*; 838, *Hypurus bertrandi*; 839, *Trigonocolus curvipes*; 840, *Mecopus trilineatus*.

Figs. 841-845. Hind wings. 841, *Cylindrocopturus adspersus*; 842, *Telephae oculata*; 843, *Balanogastris kolae*; 844, *Metialma straminea*; 845, *Cyllophorus fausciatus*.

Figs. 846-856. Legs. 846, *Dirabius calvus*; 847, *Peridinetus cretaceus*; 848-849, *Peridinetus cretaceus*. 848, femoral tooth; 849, apex of tibia, showing uncus and setal comb; 850, *Peridinetus irroratus*; 851, *Eurhinus aeneus*; 852, *Zena* sp.; 853, *Camelodes leachii*, tarsus; 854, *Nertinus suturalis*, tarsus; 855, *Catapastus squamirostris* (SEM); 856, *Baris* sp. (SEM).

Figs. 857-868. Legs. 857-860, tibial unci. 857, *Pertorcus* sp.; 858, *Madarus bistrigellus*; 859, *Cylindrocerus comma*; 860, *Demoda vittata*. 861-868, tarsi and pre-tarsal ungues. 861-862, *Baris* sp.; 863, *Demoda vittata*; 864, *Centrinopus helvinus*; 865, *Zygobarella zanthoxyli*; 866, *Baris* sp.; 867-868, *Zygobarella zanthoxyli* (lateral views).

Figs. 869-877. Tergites. 869, *Centrinus curvirostris*; 870, *Tenemotes abdominalis*; 871, *Demoda vittata*; 872, *Pycnogeraeus striatirostris*; 873, *Orissus christophori*; 874, *Nertinus suturalis*; 875, *Peridinetus irroratus*; 876, *Leptoschoinus fucatus*; 877, *Barilepton filiforme*.

Figs. 878-886. Tergites. 878, *Garnia* sp.; 879, *Eisonyx crassipes*; 880, *Dirabius calvus*; 881, *Xystus ruficollis*; 882, *Parasomenes curvirostris*; 883, *Plocamus echidna*; 884, *Odontocorynus creperus*; 885, *Calandrinus grandicollis*; 886, *Camelodes leachii*.

Figs. 887-895. Tergites. 887, *Pseudotorcus rufipes*; 888, *Lipancylus brevirostris*; 889, *Eurhinus aeneus*; 890, *Diorymerus lancifer*; 891, *Limnobaris* sp.; 892, *Anthinobaris* sp.; 893, *Anthinobaris* sp.; 894, *Orthoris crotchii*; 895, *Orthoris crotchii*.

Figs. 896-904. Tergites. 896, *Lamprobaris cicullata*; 897, *Pseudogeraeus macropterus*; 898, *Anavallius ruficornis*; 899, *Solenosternus dividuus*; 900, *Conoproctus quadripustulatus*; 901, *Athesapeuta vinculata*; 902, *Cyrtepistomus castanaeus*; 903, *Bagous transversus*; 904, *Cossonus impressifrons*.

Figs. 905-912. Tergites. 905, *Hylurgops planirostris*; 906, *Mononychus vulpeculus*; 907, *Trigonocolus curvipes*; 908, *Mecopus trilineatus*; 909, *Telephae oculata*; 910, *Balanogastris kolae*; 911, *Cyllophorus fausciatus*; 912, *Parorobitis gibbus*.

Figs. 913-923. Tergites. 913, *Diastethus eurthinoides*; 914, *Cylindridia prolixa*; 915, *Zygobarella tristicula*; 916, *Pertorcus* sp.; 917-918, *Acythopeus* sp.; 919, *Athesapeuta* sp., enlargement of spiculate patches; 920-921, *Amercedes subulirostris*, 7th tergite and associated plectra; 922-923, *Deipyrus hirsutulus*, 7th tergite and associated plectra.

Figs. 924-932. 924-927, tergites. 924, *Pycnogeraeus modestus*, 7th tergite; 925, *Pycnogeraeus ochraceus*, plectra on 7th tergite; 926-927, *Diastethus eurthinoides*, 7th tergite and associated plectra. 928-932, files on ventral apex of elytra. 928, *Zygobaris nitens*; 929, *Idiostethus subcalvus*; 930, *Diastethus eurthinoides*; 931, *Pachybaris porosa*; 932, *Pseudorthoris devexus*.

Figs. 933-948. Ventrites. 933, *Centrinus curvirostris*; 934, *Pycnogeraeus striatirostris*; 935, *Orissus christophori*; 936, *Nertinus suturalis*; 937, *Peridinetus irroratus*; 938, *Barilepton filiforme*; 939, *Garnia* sp.; 940, *Eisonyx crassipes*; 941, *Dirabius calvus*; 942, *Xystus ruficollis*; 943, *Parasomenes curvirostris*; 944, *Plocamus echidna*; 945, *Odontocorynus creperus*; 946, *Calandrinus grandicollis*; 947, *Camelodes leachii*; 948, *Pseudotorcus rufipes*.

Figs. 949-964. Ventrites. 949, *Lipancylus brevirostris*; 950, *Eurhinus aeneus*; 951, *Limnobaris* sp.; 952, *Anthinobaris* sp.; 953, *Anthinobaris* sp.; 954, *Orthoris crotchii*; 955, *Lamprobaris cicullata*; 956, *Pseudogeraeus macropterus*; 957, *Anavallius ruficornis*; 958, *Conoproctus quadripustulatus*; 959, *Athesapeuta vinculata*; 960, *Cyrtepistomus castanaeus*; 961, *Cossonus impressifrons*; 962, *Hylurgops planirostris*; 963, *Mononychus vulpeculus*; 964, *Balanogastris kolae*.

Figs. 965-966. Ventrites. 965, *Cyllphorus fausciatus*; 966, *Parorobitis gibbus*.

Figs. 967-975. Ventrites (SEM's). 967, *Idiostethus tubulatus*; 968, *Cylindridia prolixa*; 969, *Pertorcus* sp.; 970, *Pertorcus* sp.; 971, *Acythopeus* sp.; 972, *Stethobaris commixta*; 973, *Stethobaris laevimargo*; 974, *Pycnogeraeus striatirostris*; 975, *Pachybaris porosa*.

Figs. 976-980. Ventrites (SEM's). 976, *Acythophanes* sp.; 977, *Spilobaris* sp.; 978, *Spilobaris* sp.; 979, *Acythopeus* sp.; 980, *Pycnogeraeus modestus*.

Figs. 981-984. Terminalia. 981-982, *Anthinobaris* sp., male genitalia. 981, aedeagus; 982, spiculum gastrale; 983-984, *Peridinetus cretaceus*, female genitalia. 983, 8th sternite; 984, spermatheca.

Figs. 985-993. Male genitalia: aedeagus and 9th sternite (dorsal view). 985, *Centrinus curvirostris*; 986, *Demoda vittata*; 987, *Acythophanes* sp.; 988, *Pycnogeraeus modestus*; 989, *Stethobaroides nudiventris*; 990, *Pycnogeraeus ochraceus*; 991, *Orissus christophori*; 992, *Orissus meigenii*; 993, *Pantoteles tenvirostris*.

Figs. 994-1004. Male genitalia: aedeagus and 9th sternite (dorsal view). 994, *Peridinetus cretaceus*; 995, *Nertinus suturalis*; 996, *Peridinetus irroratus*; 997, *Leptoschoinus fucatus*; 998, *Barilepton filiforme*; 999, *Garnia* sp.; 1000, *Eisonyx crassipes*; 1001, *Dirabius calvus*; 1002, *Xystus ruficollis*; 1003, *Plocamus echidna*; 1004, *Odontocorynus creperus*.

Figs. 1005-1012. Male genitalia: aedeagus and 9th sternite (dorsal view). 1005, *Calandrinus grandicollis*; 1006, *Camelodes leachii*; 1007, *Pseudotorcus rufipes*; 1008, *Madopterus talpa*; 1009, *Lipancylus brevirostris*; 1010, *Diorymerus lancifer*; 1011, *Eurhinus aeneus*; 1012, *Acythopeus* sp.

Figs. 1013-1021. Male genitalia: aedeagus and 9th sternite (dorsal view). 1013, *Spilobaris* sp.; 1014, *Anthinobaris* sp.; 1015, *Orthoris crotchii*; 1016, *Lamprobaris cicullata*; 1017, *Pseudogeraeus macropterus*; 1018, *Solenosternus dividuus*; 1019, *Anavallius ruficornis*; 1020, *Pardisomus biplagiatus*; 1021, *Pteracanthus smidtii*.

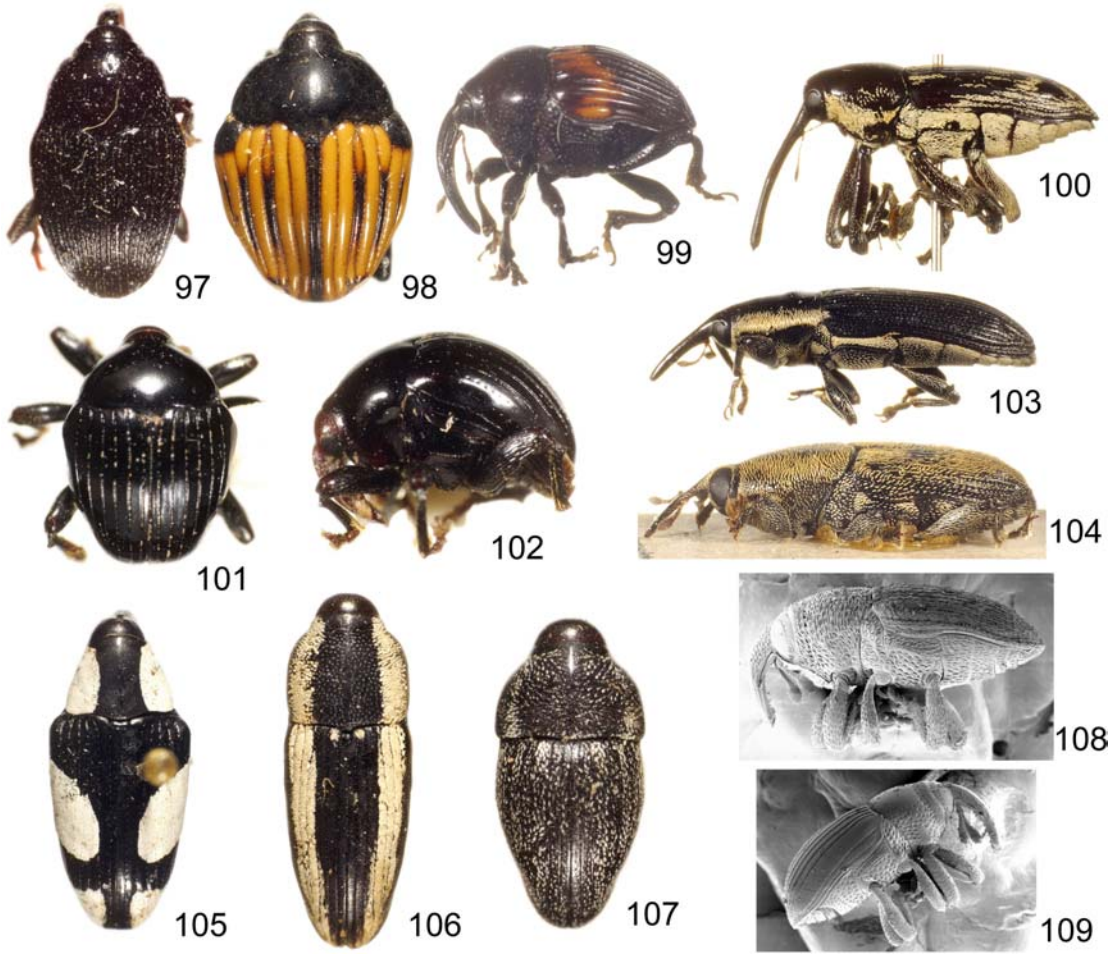
Figs. 1022-1030. Male genitalia: aedeagus and 9th sternite (dorsal view). 1022, *Stereobaris interpunctata*; 1023, *Conoproctus quadripustulatus*; 1024, *Athesapeuta vinculata*; 1025, *Derelomus basalis*; 1026, *Cryptorhynchus lapathi*; 1027, *Dryophthorus americanus*; 1028, *Cholus rana*; 1029, *Cossonus impressifrons*; 1030, *Curculio pardalis*.

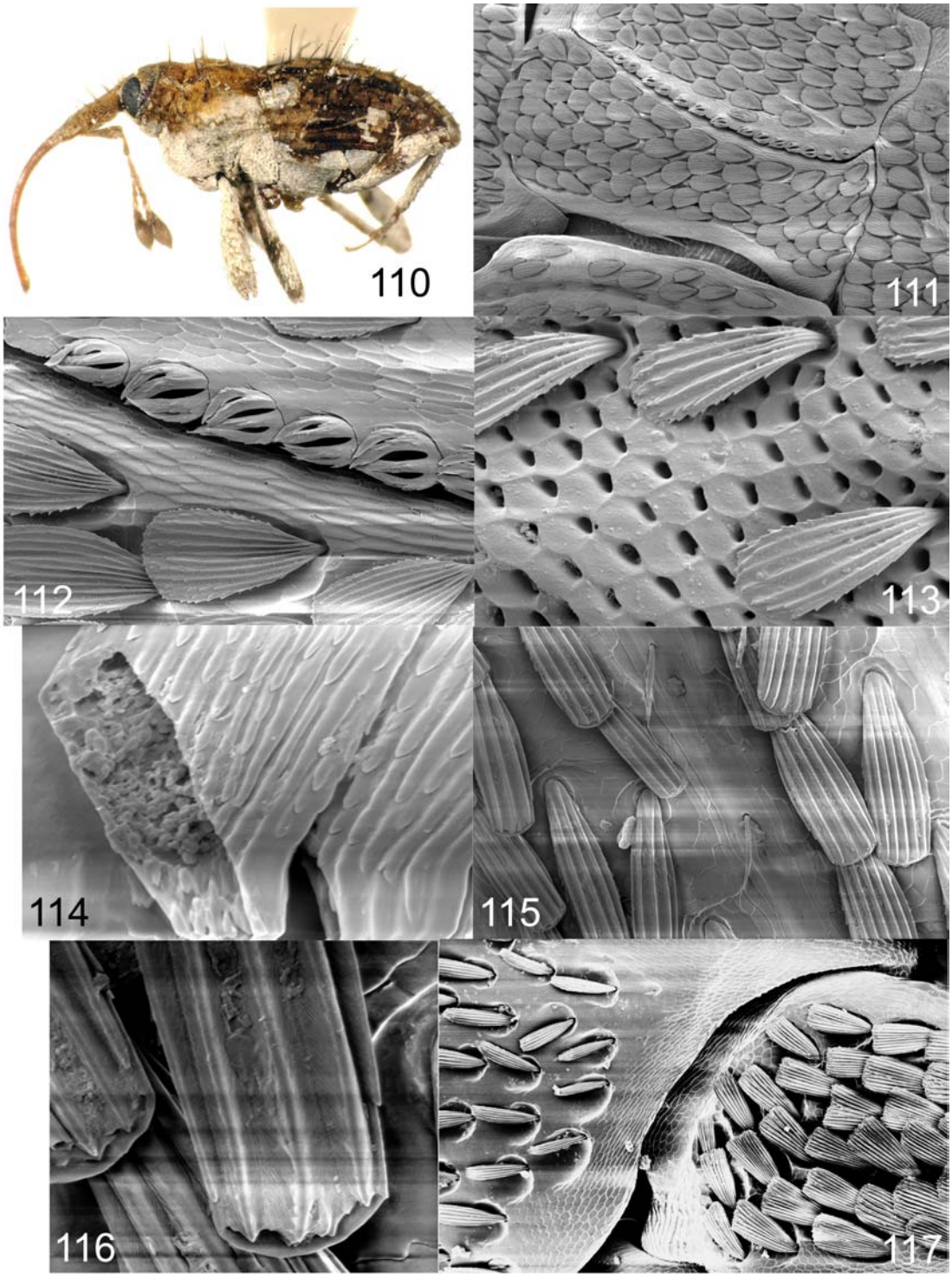
Figs. 1031-1040. Male genitalia: aedeagus and 9th sternite (dorsal view). 1031, *Hylurgops planirostris*; 1032, *Trichodocerus* sp.; 1033, *Coeliodes flavicaudis*; 1034, *Trigonocolus curvipes*; 1035, *Mononychus vulpeculus*; 1036, *Hypurus bertrandi*; 1037, *Mecopus trilineatus*; 1038, *Cylindrocopturus adspersus*; 1039, *Telephae oculata*; 1040, *Balanogastris kolae*.

Figs. 1041-1043. Male genitalia: aedeagus and 9th sternite (dorsal view). 1041, *Metialma straminea*; 1042, *Cyllophorus fausciatus*; 1043, *Parorobitis gibbus*.

Figs. 1044-1051. female genitalia: 8th sternite and spermatheca. 1044, *Diastethus eurthinoides*; 1045, *Tenemotes abdominalis*; 1046, *Anthinobaris* sp.; 1047, *Pycnogeraeus striatirostris*; 1048, *Nertinus suturalis*; 1049, *Peridinetus cretaceus*; 1050, *Parasomenes curvirostris*; 1051, *Strongylotes squamans*.

Figs. 1052-1058. female genitalia: 8th sternite and spermatheca. 1052, *Limnobaris* sp.; 1053, *Zena* sp.; 1054, *Anthinobaris* sp.; 1055, *Orthoris crotchii*; 1056, *Telemus* sp.; 1057, *Athesapeuta vinculata*; 1058, *Cyrtepistomus castanaeus*.

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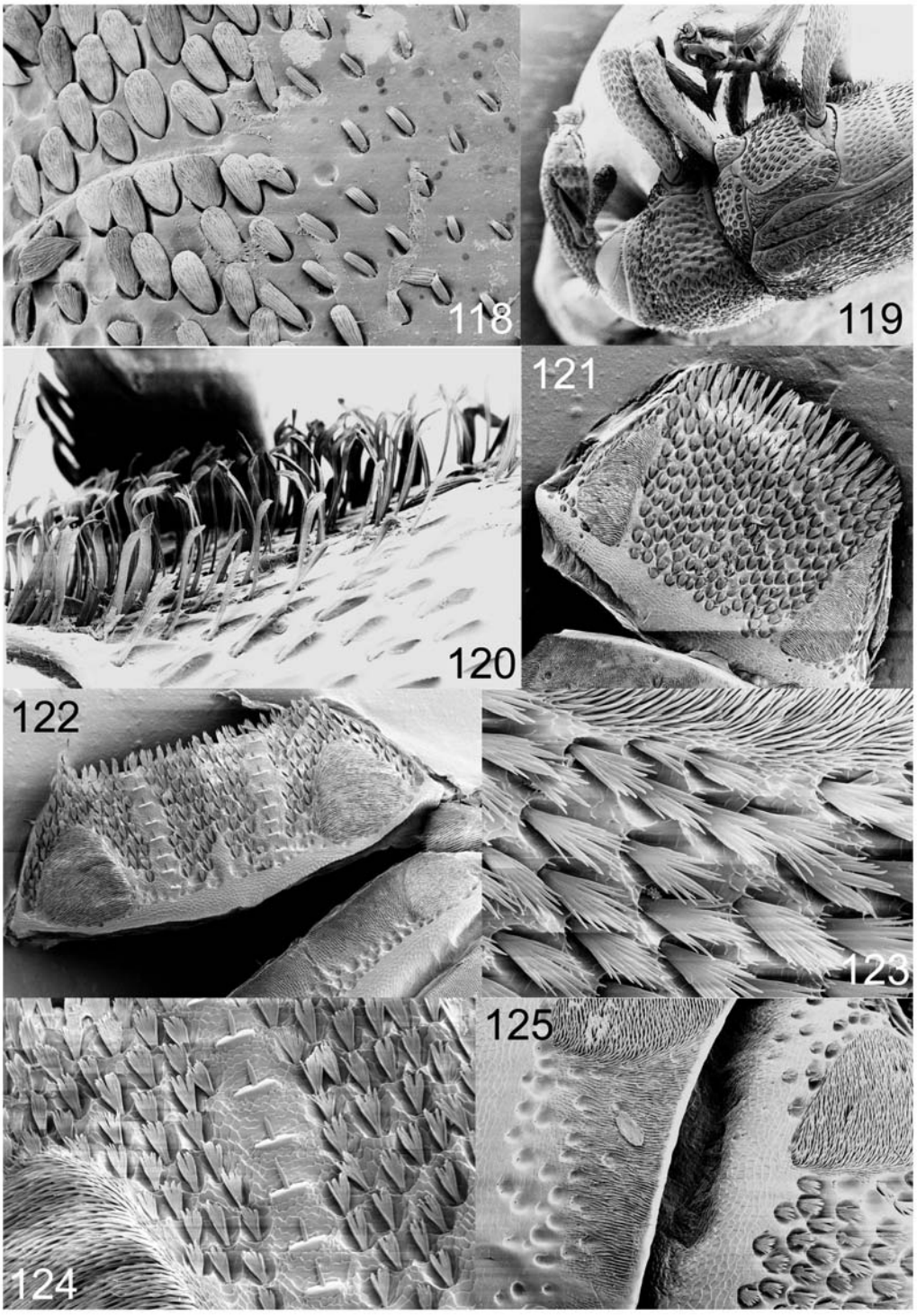
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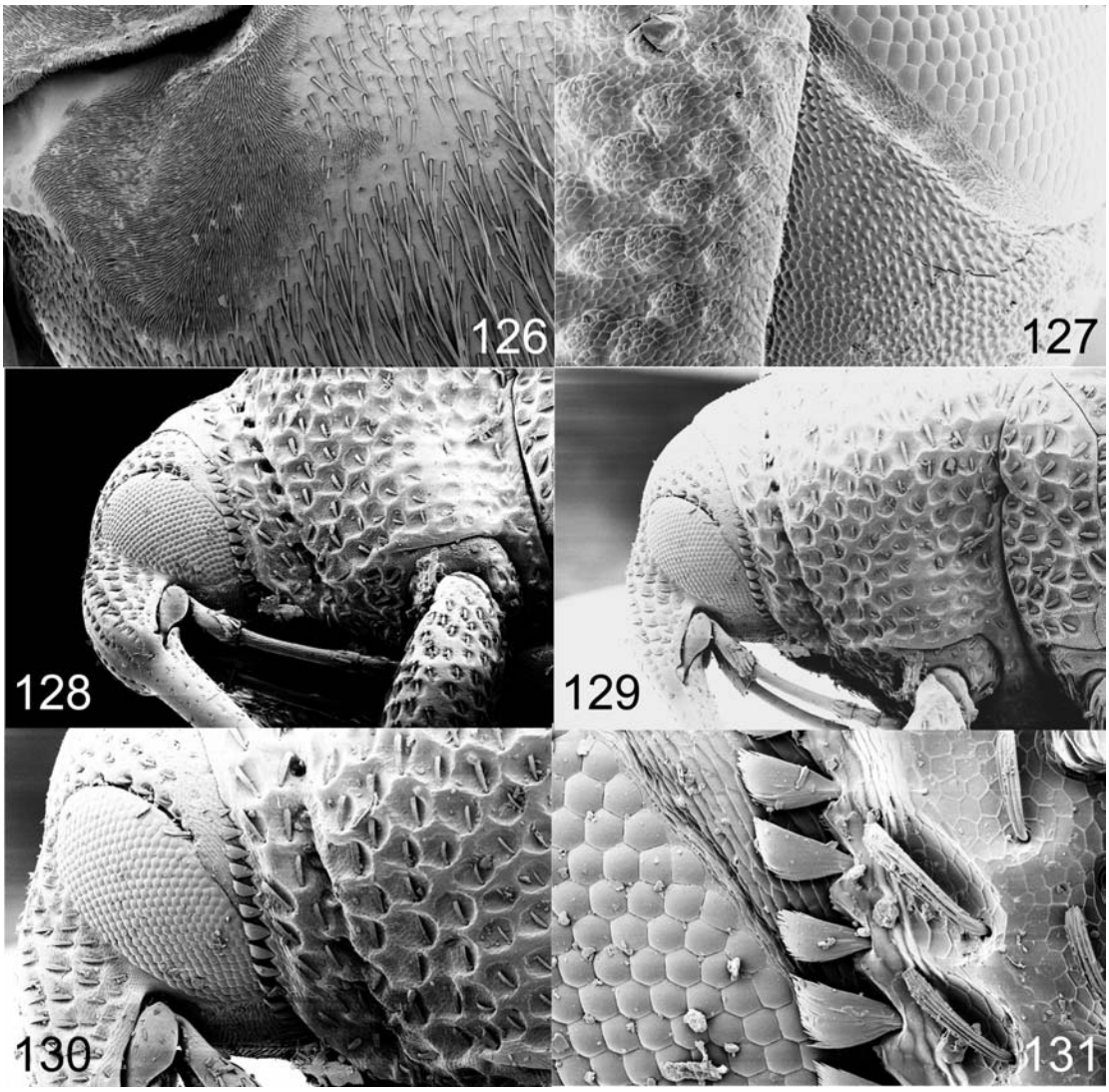
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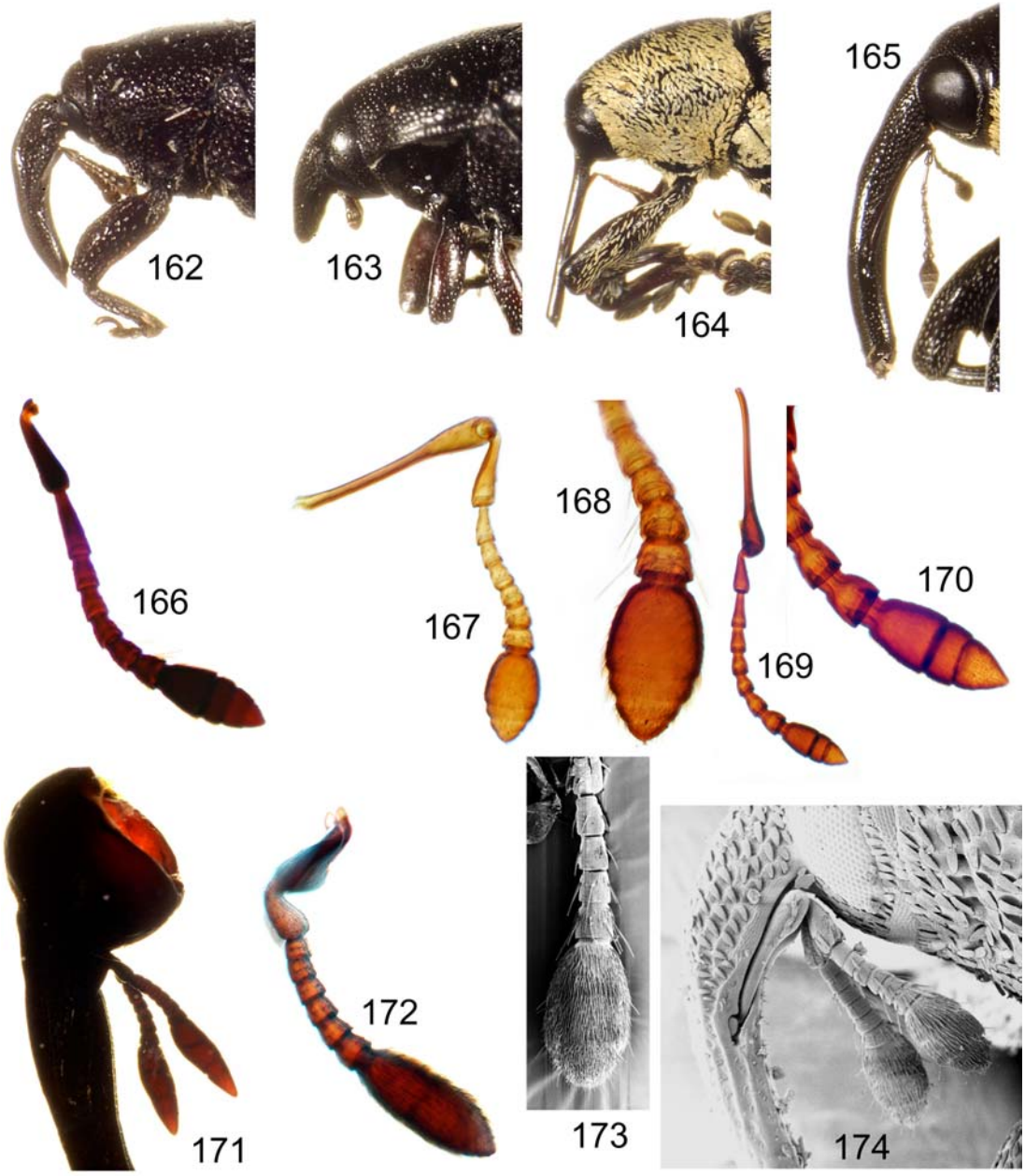
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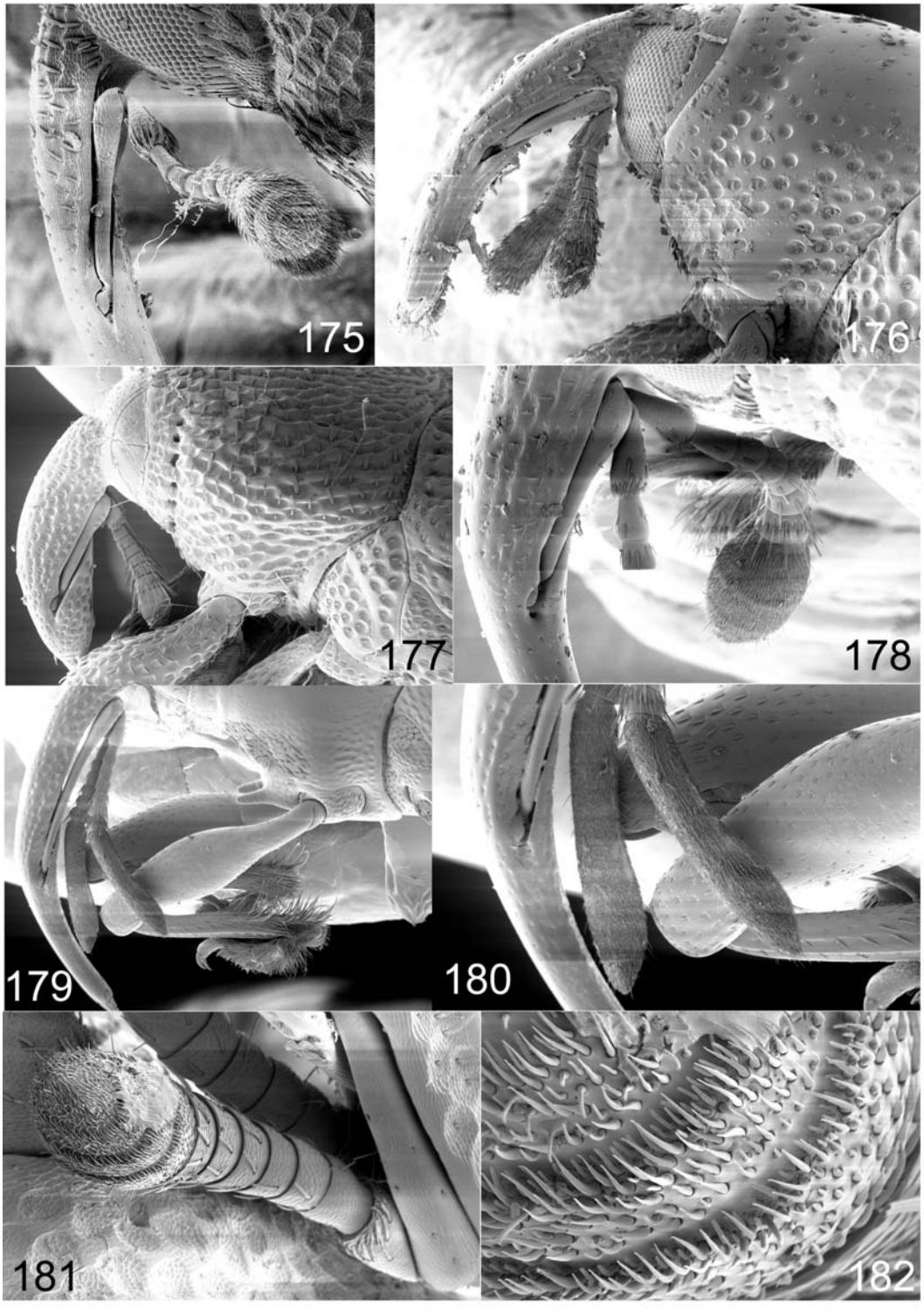
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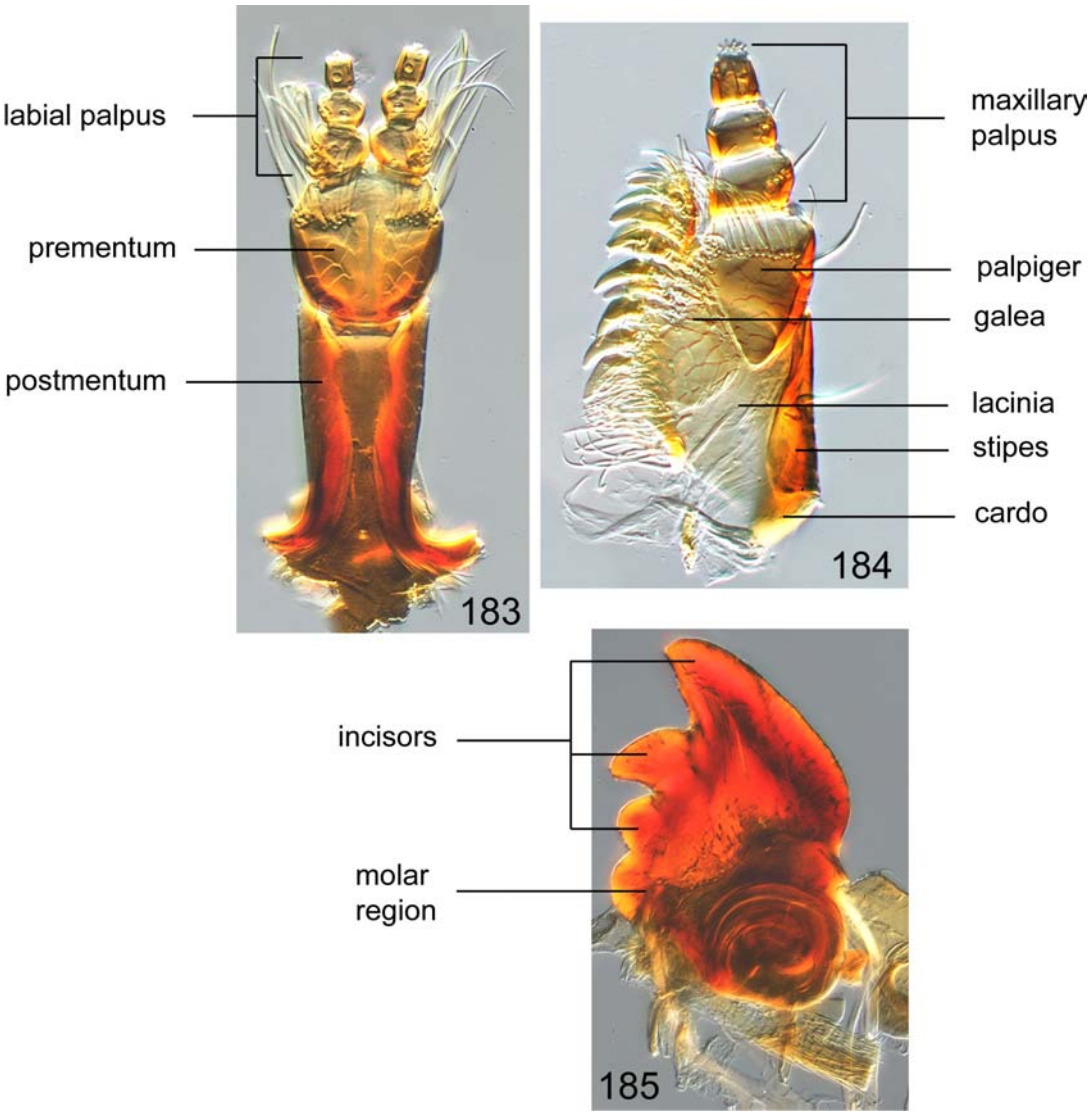
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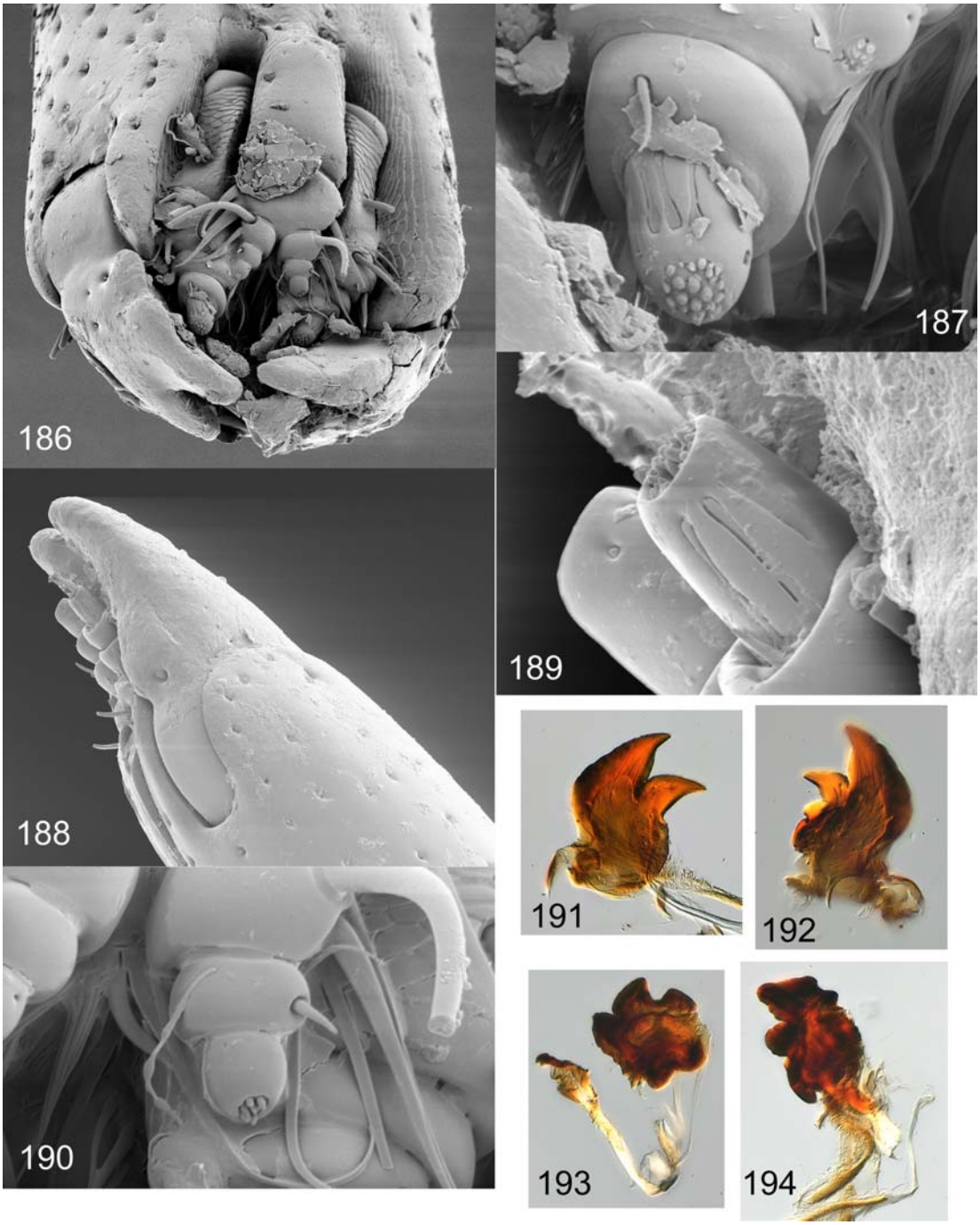
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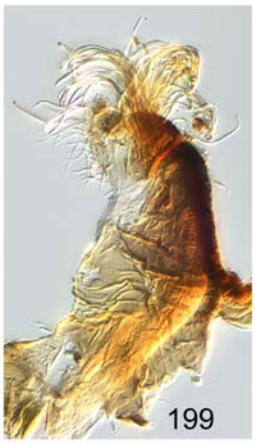
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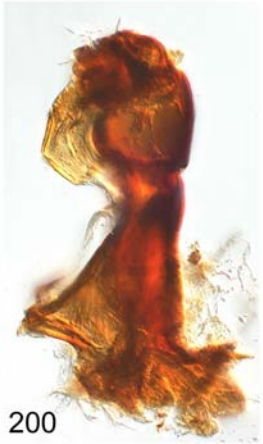
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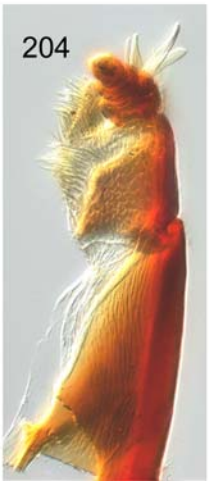
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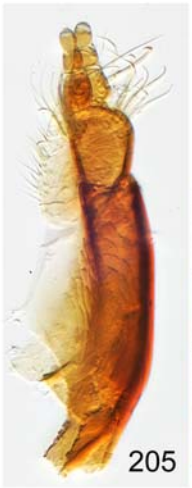
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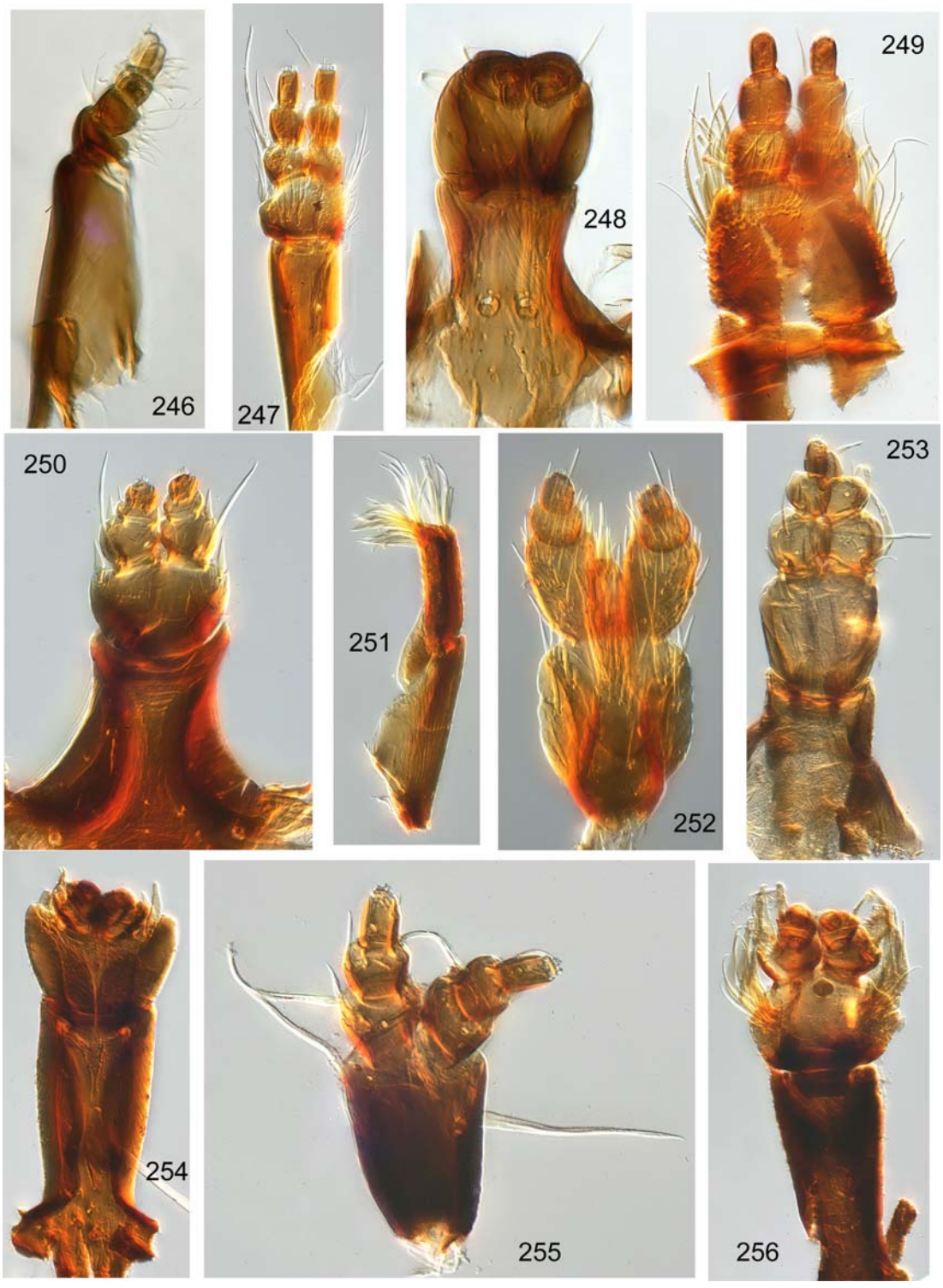
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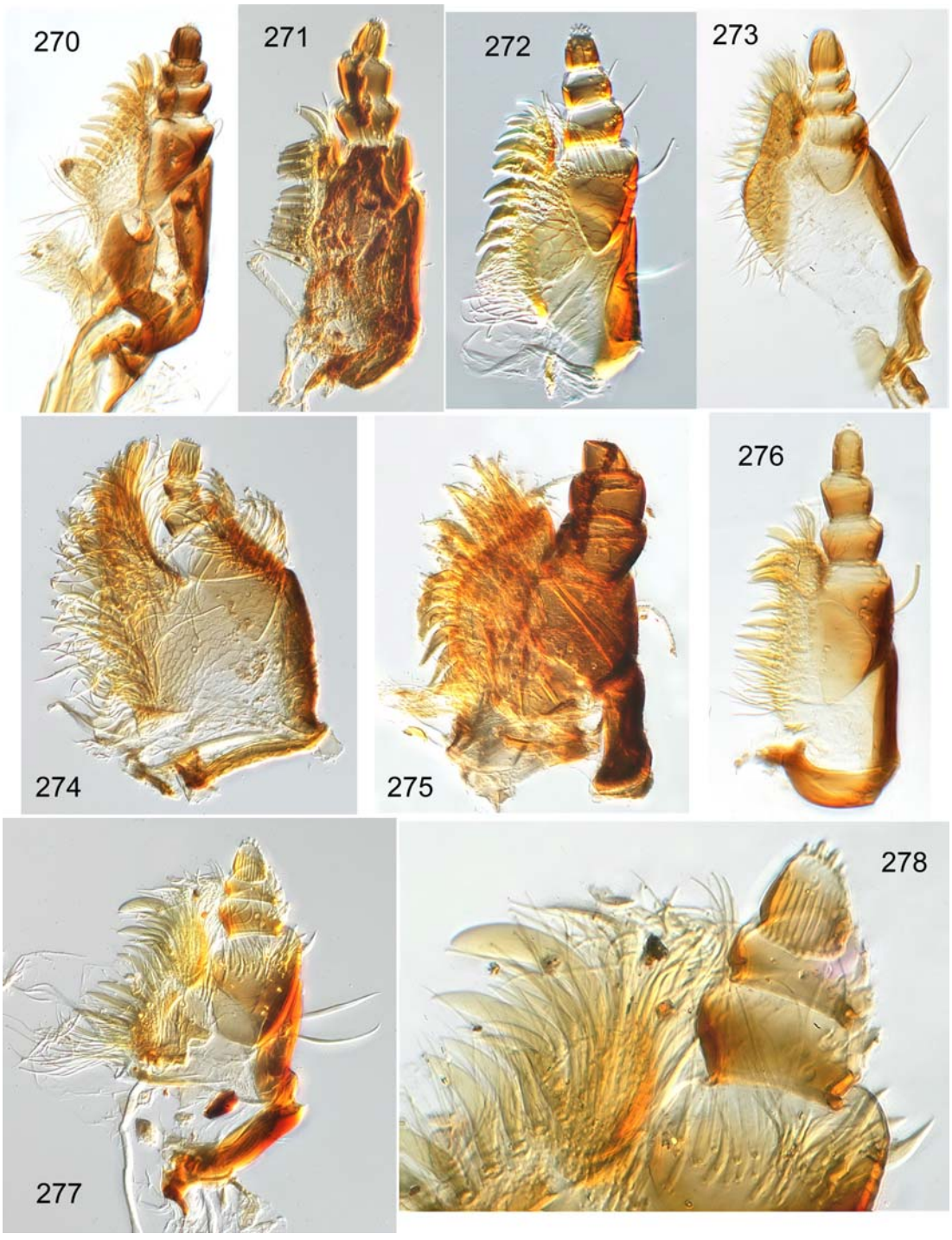
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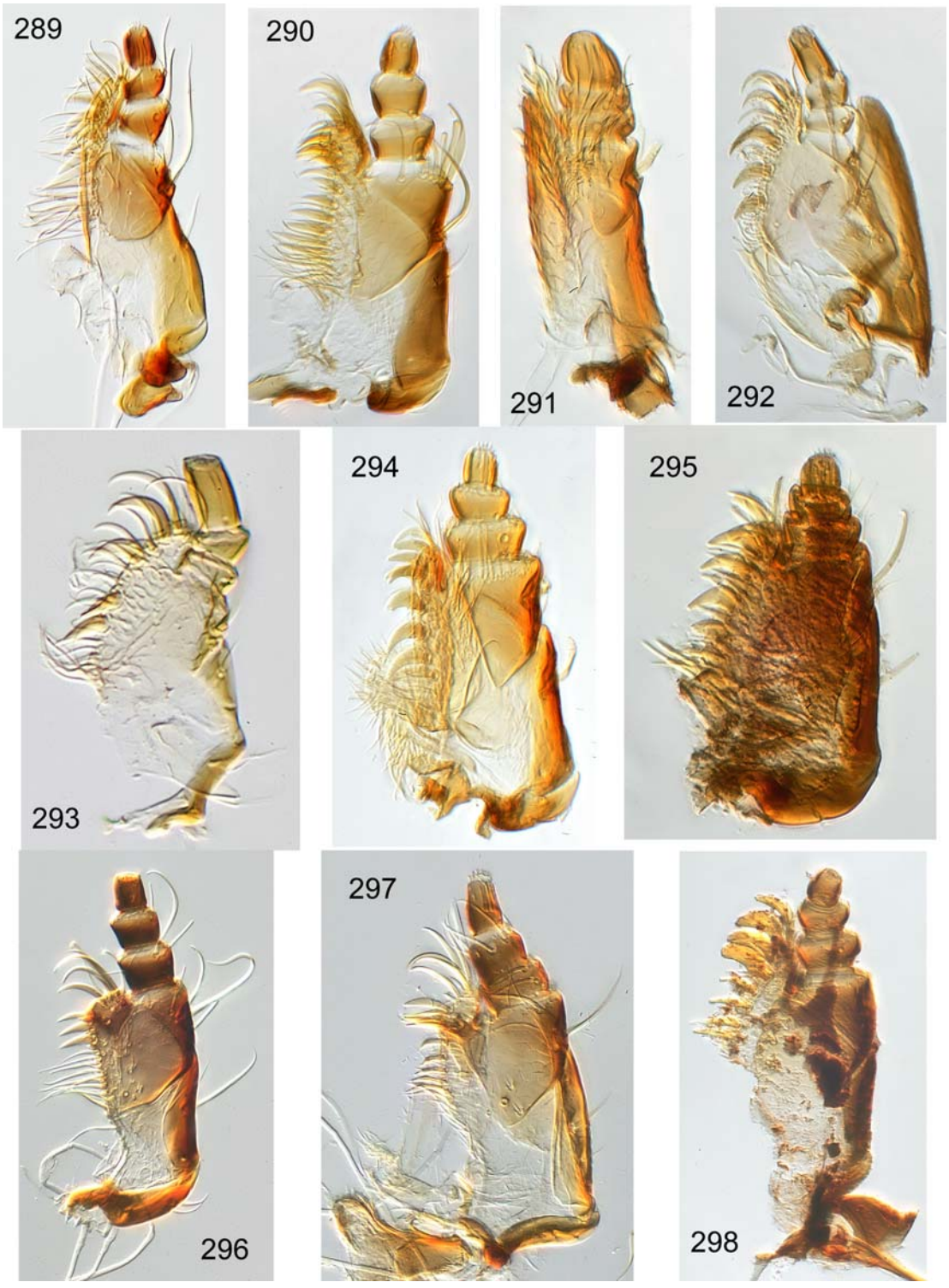
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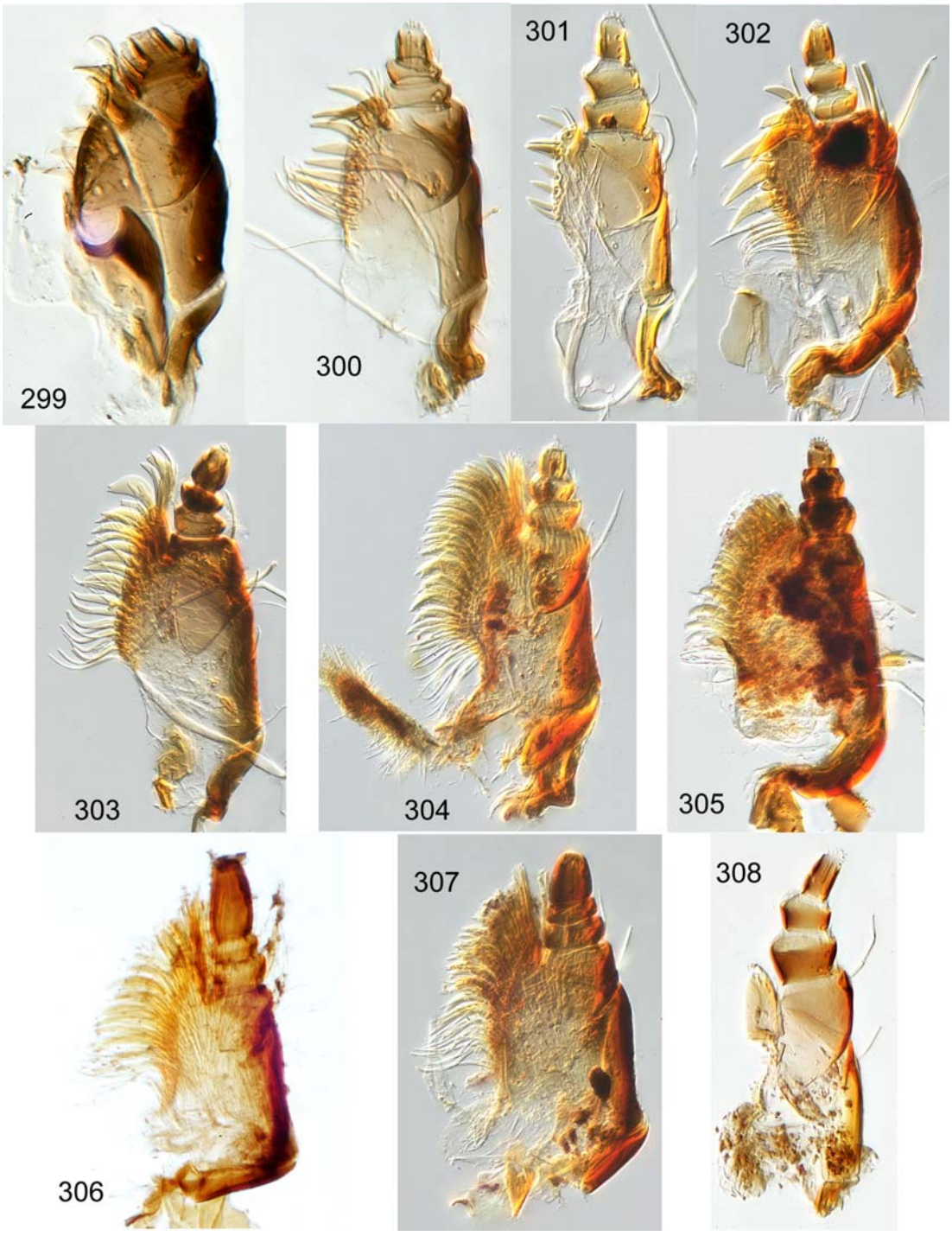
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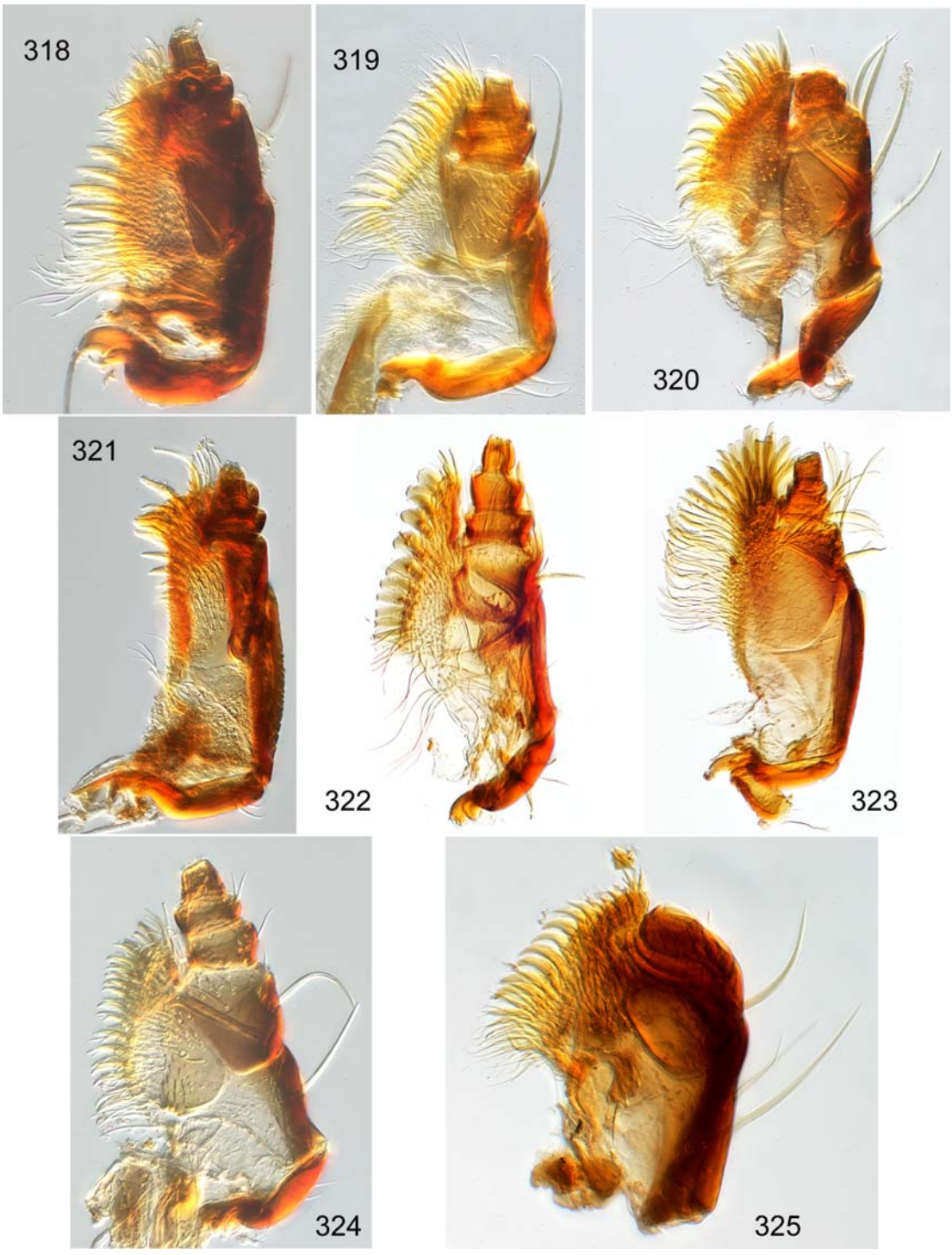
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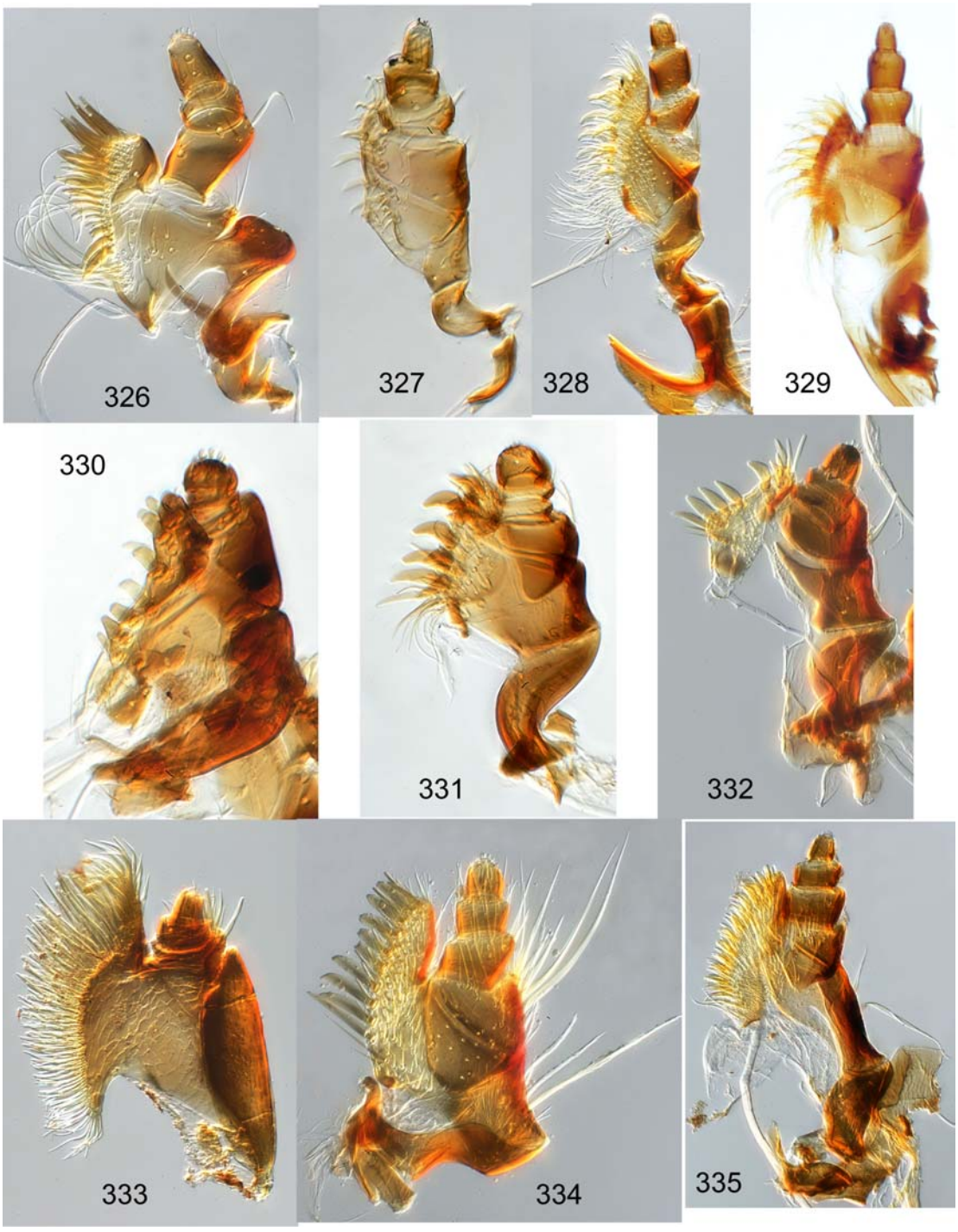
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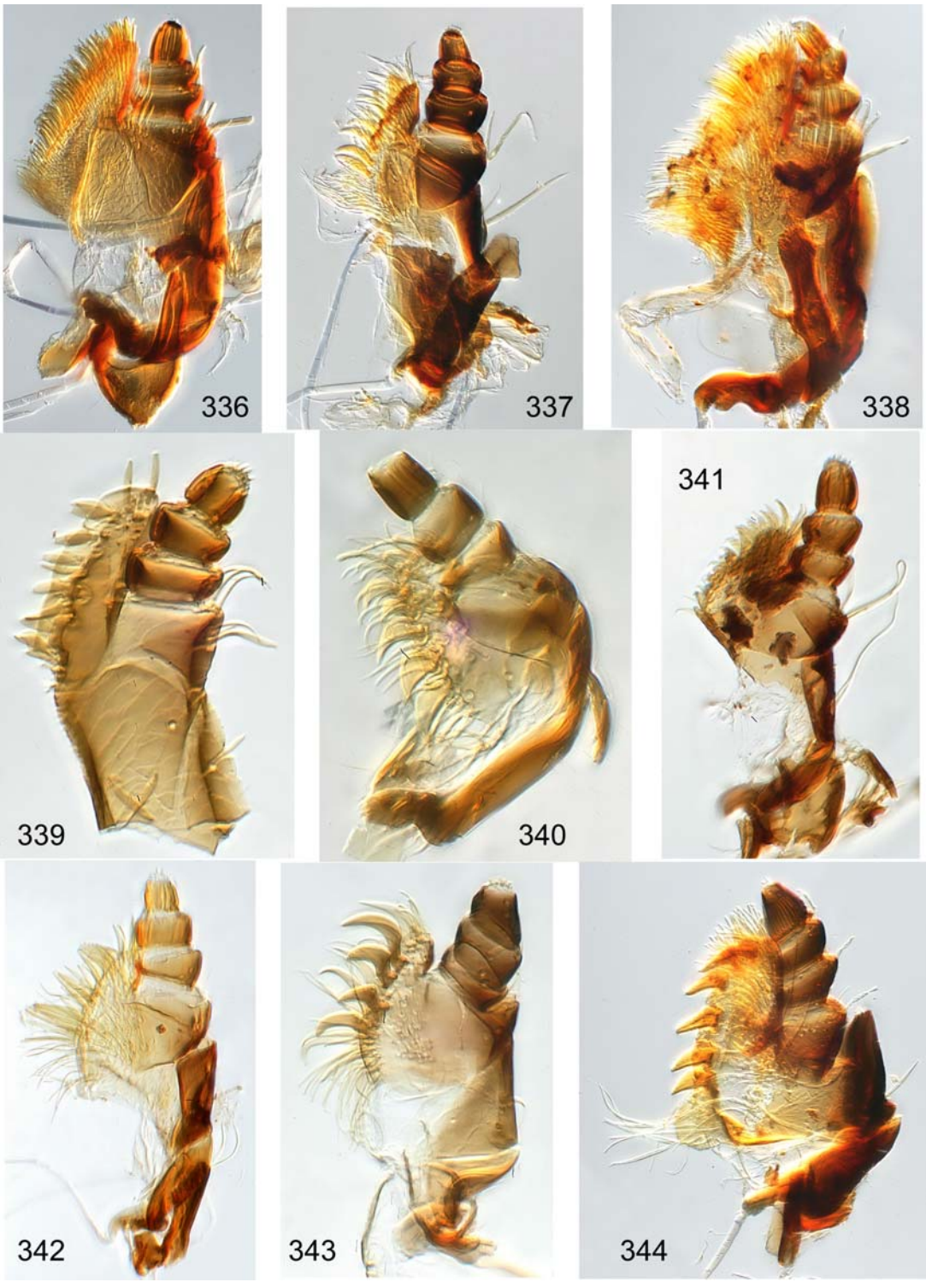
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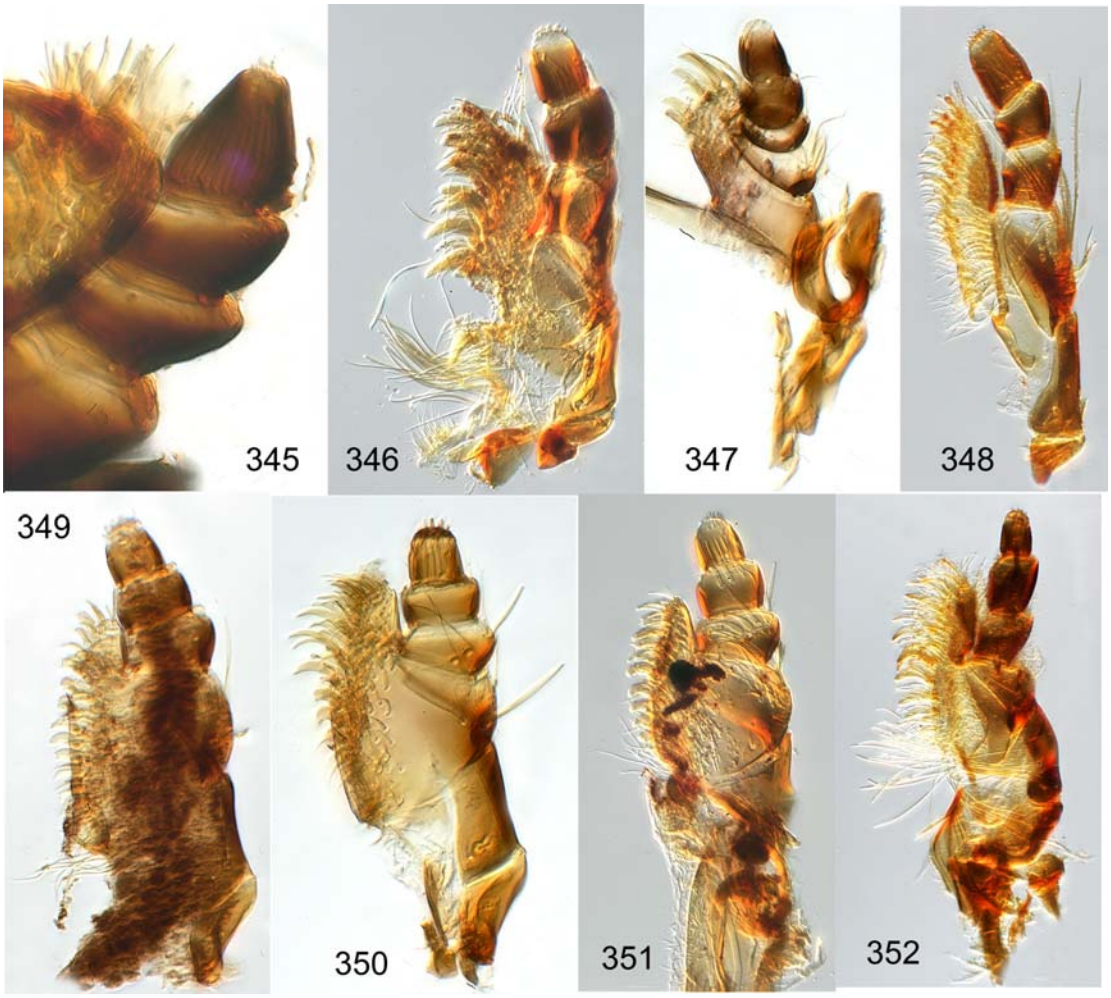
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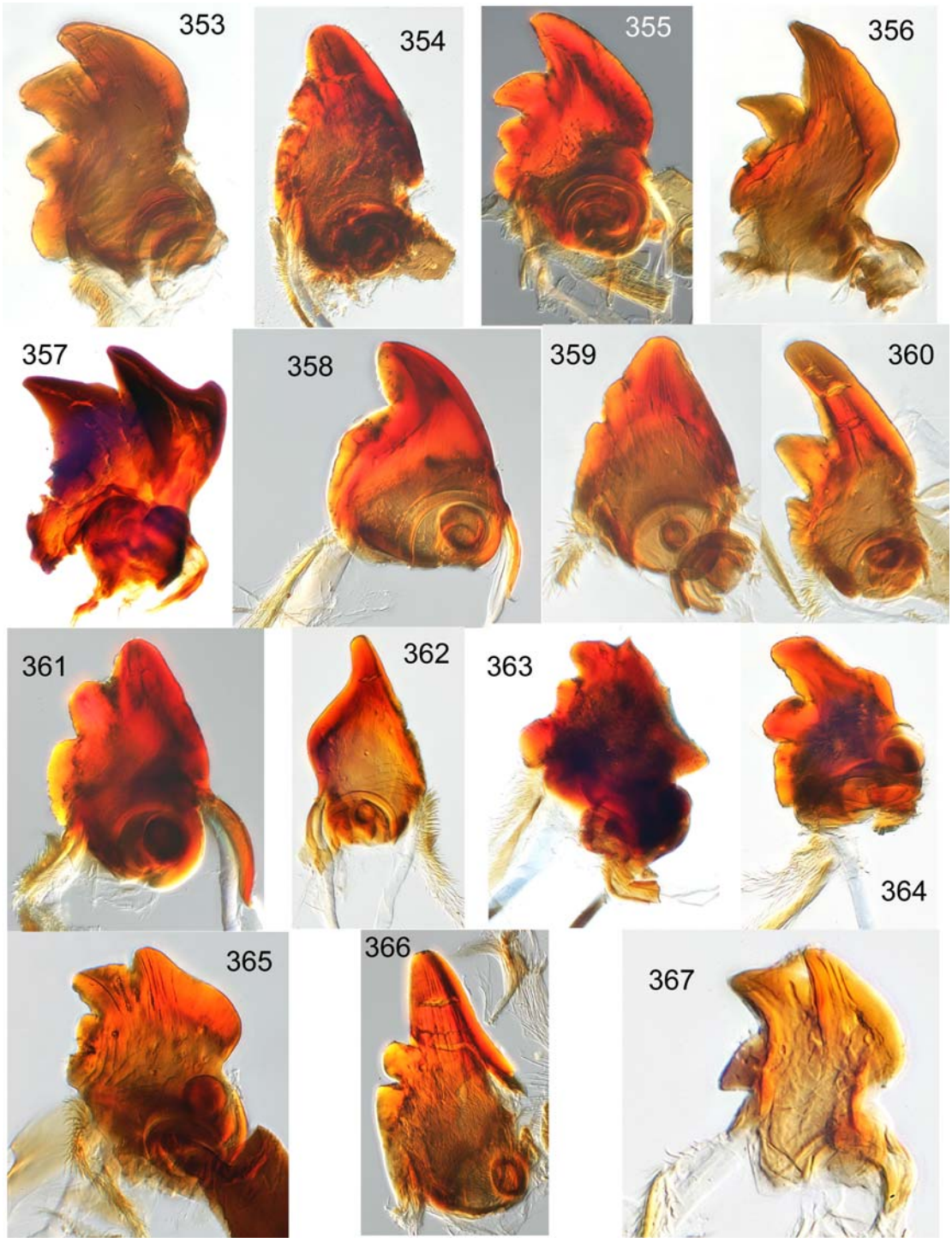
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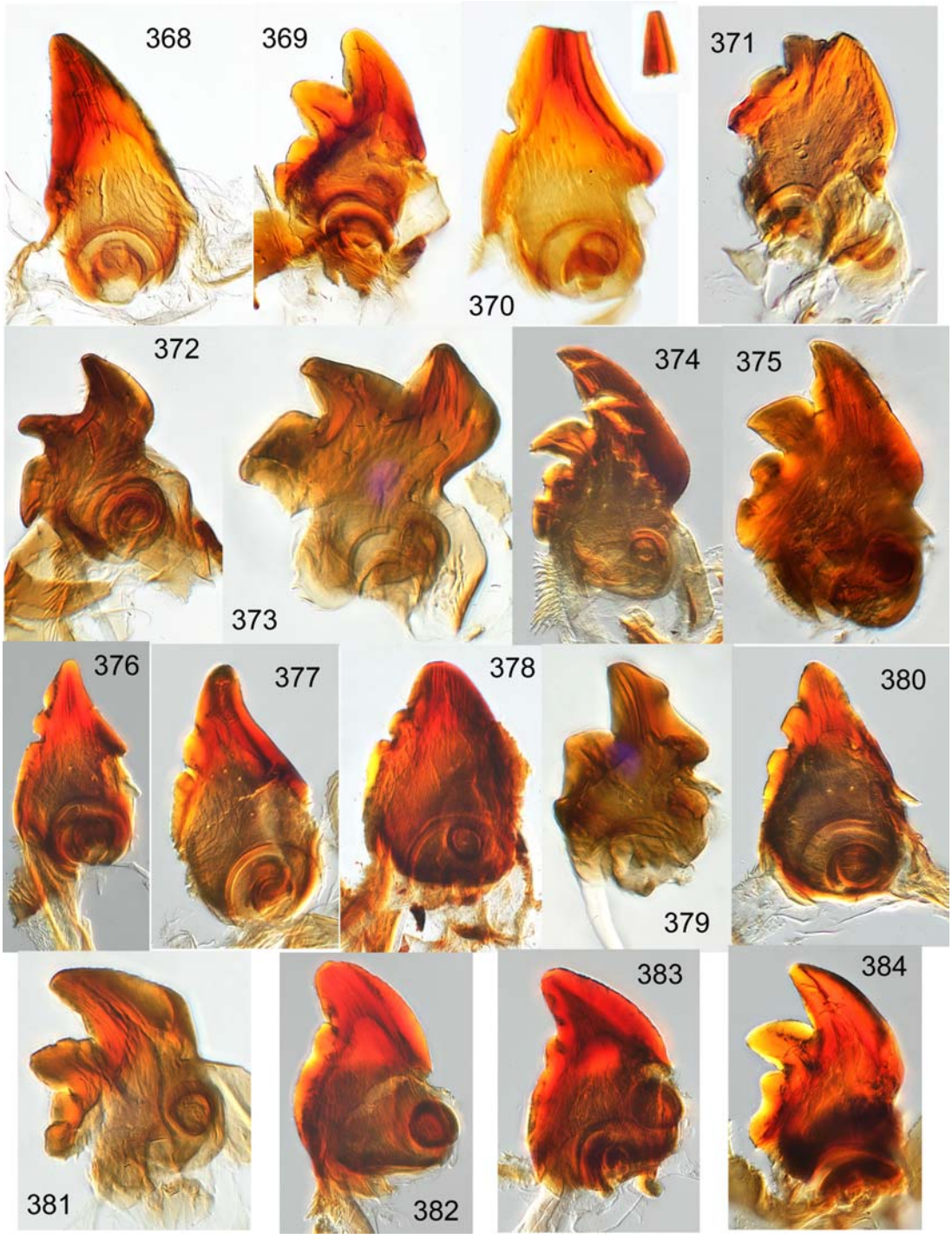
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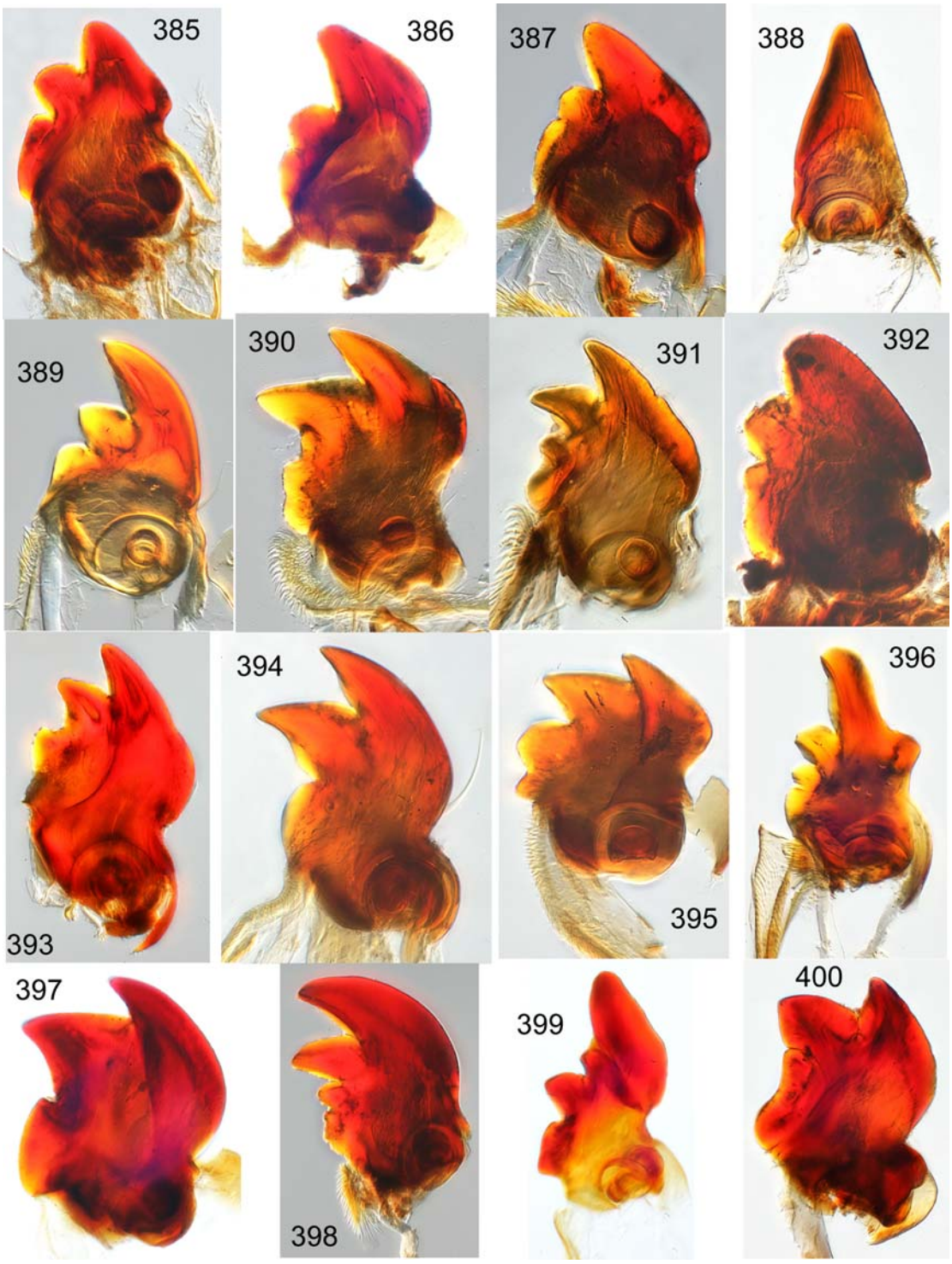
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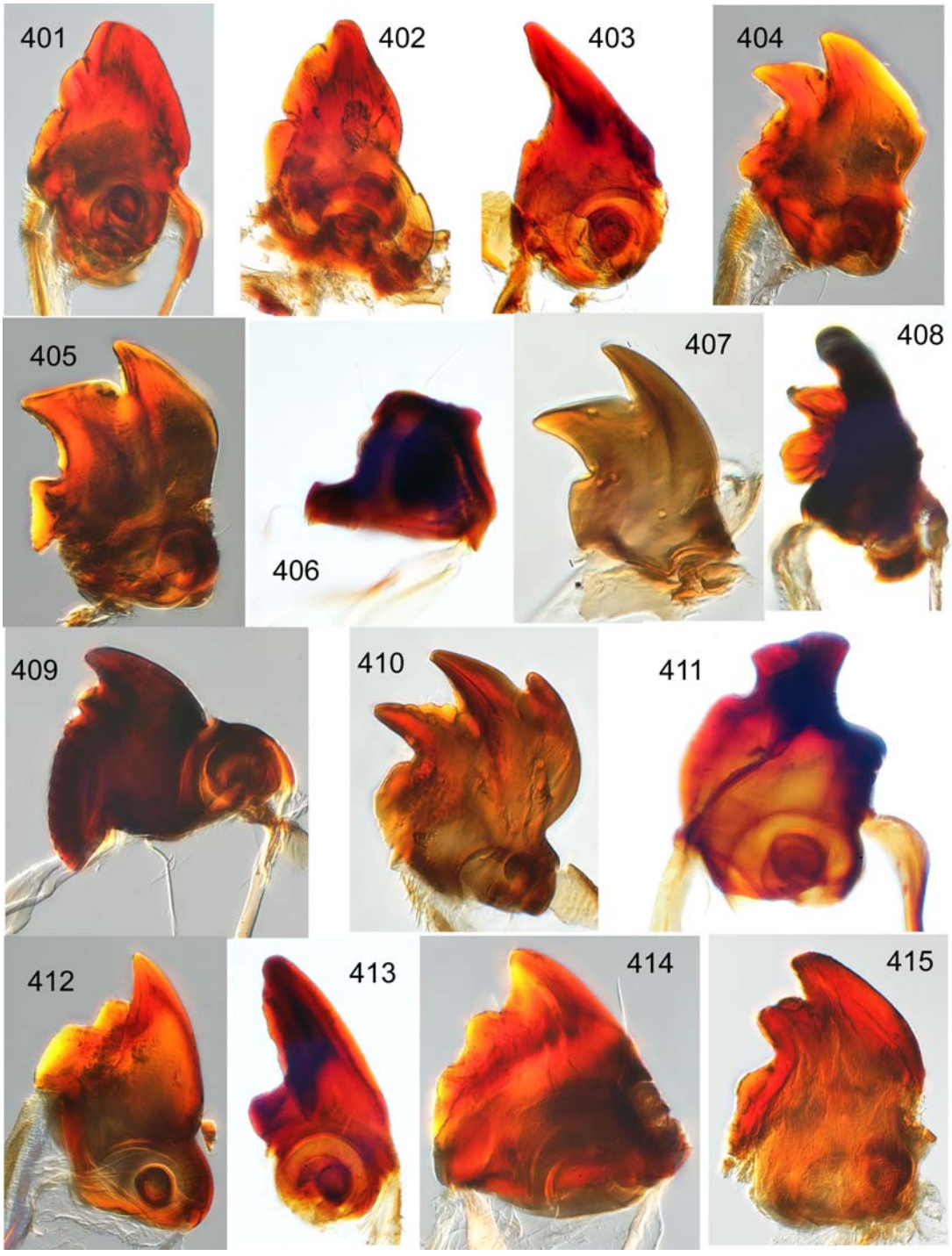
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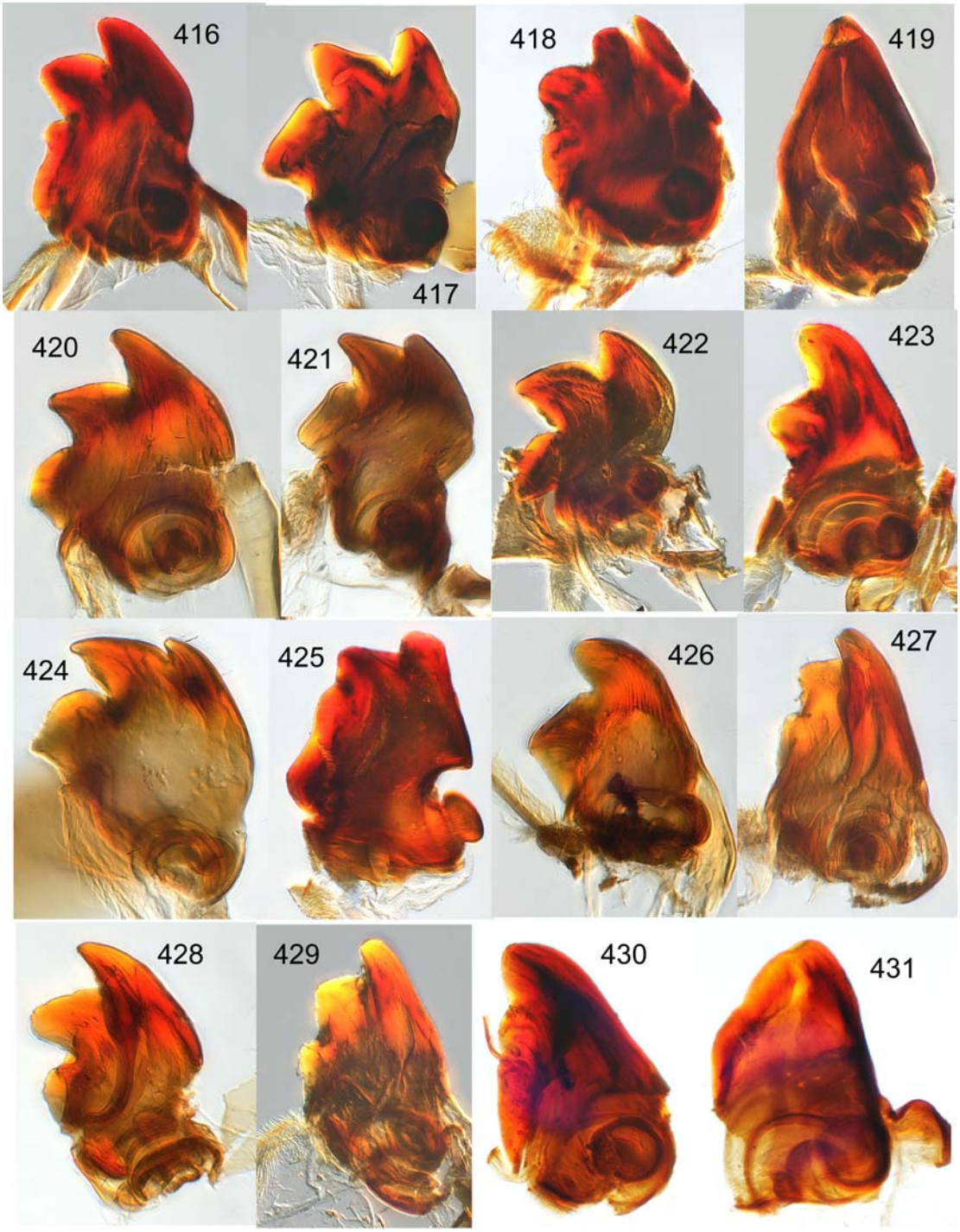
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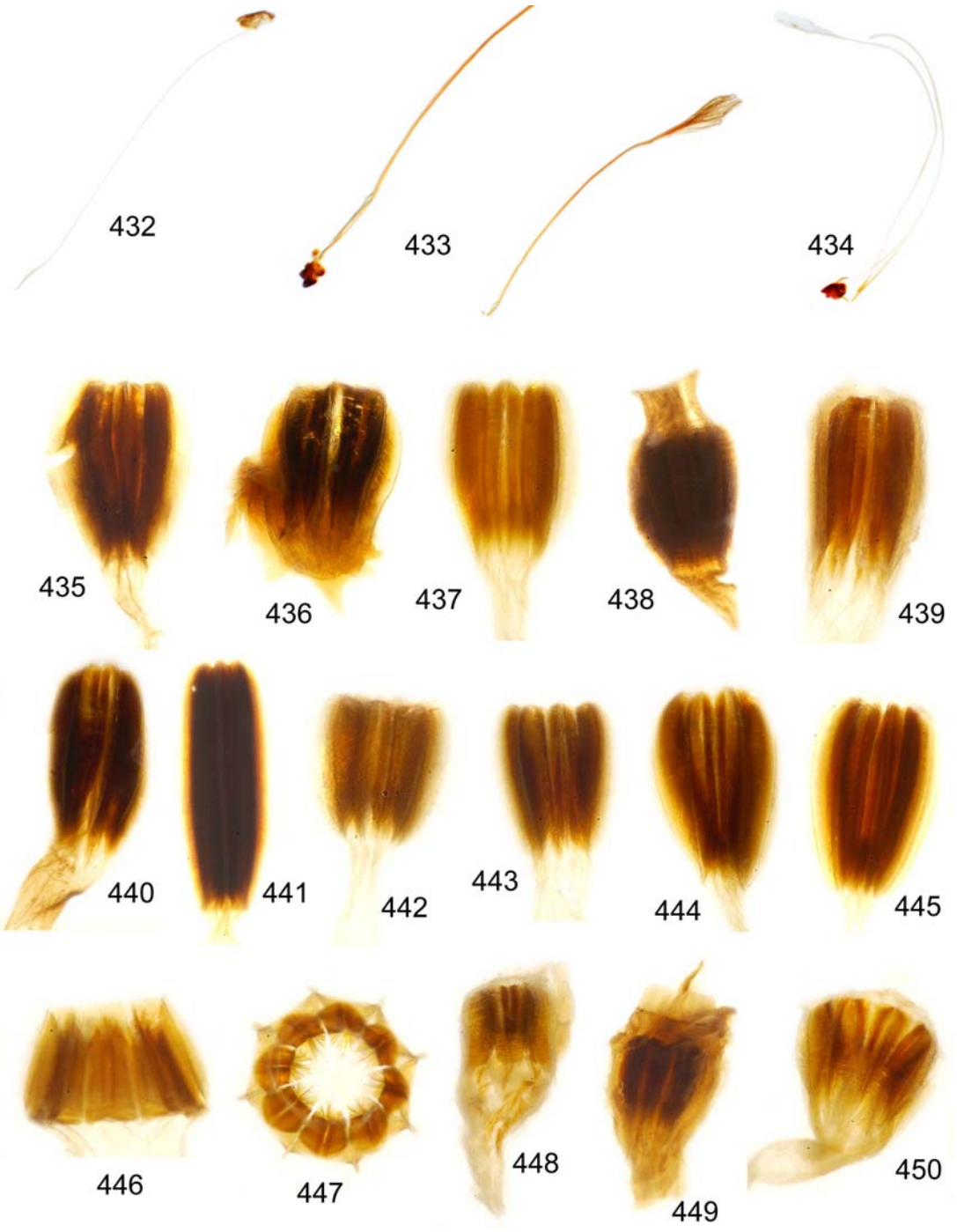
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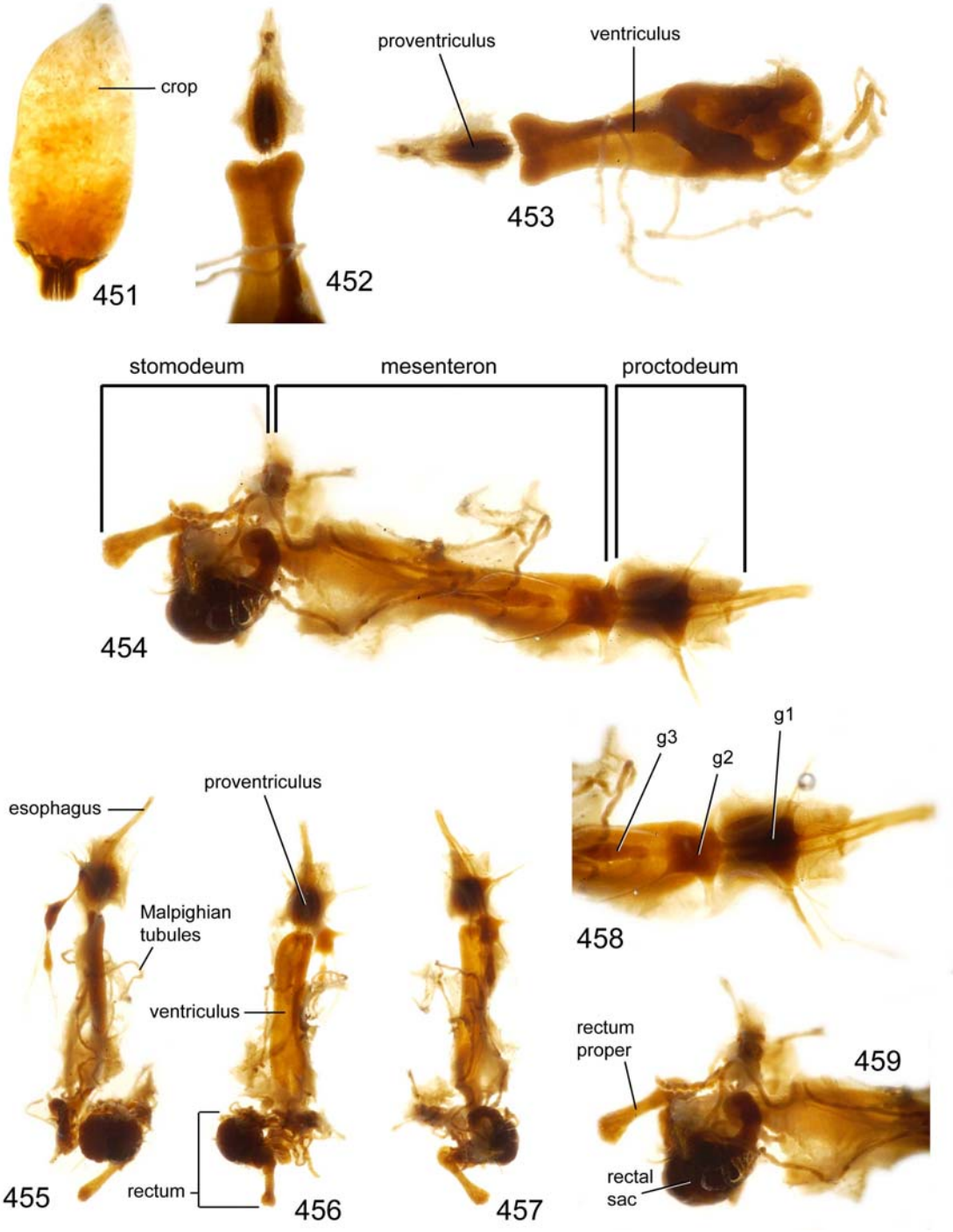
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g2
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rectum proper
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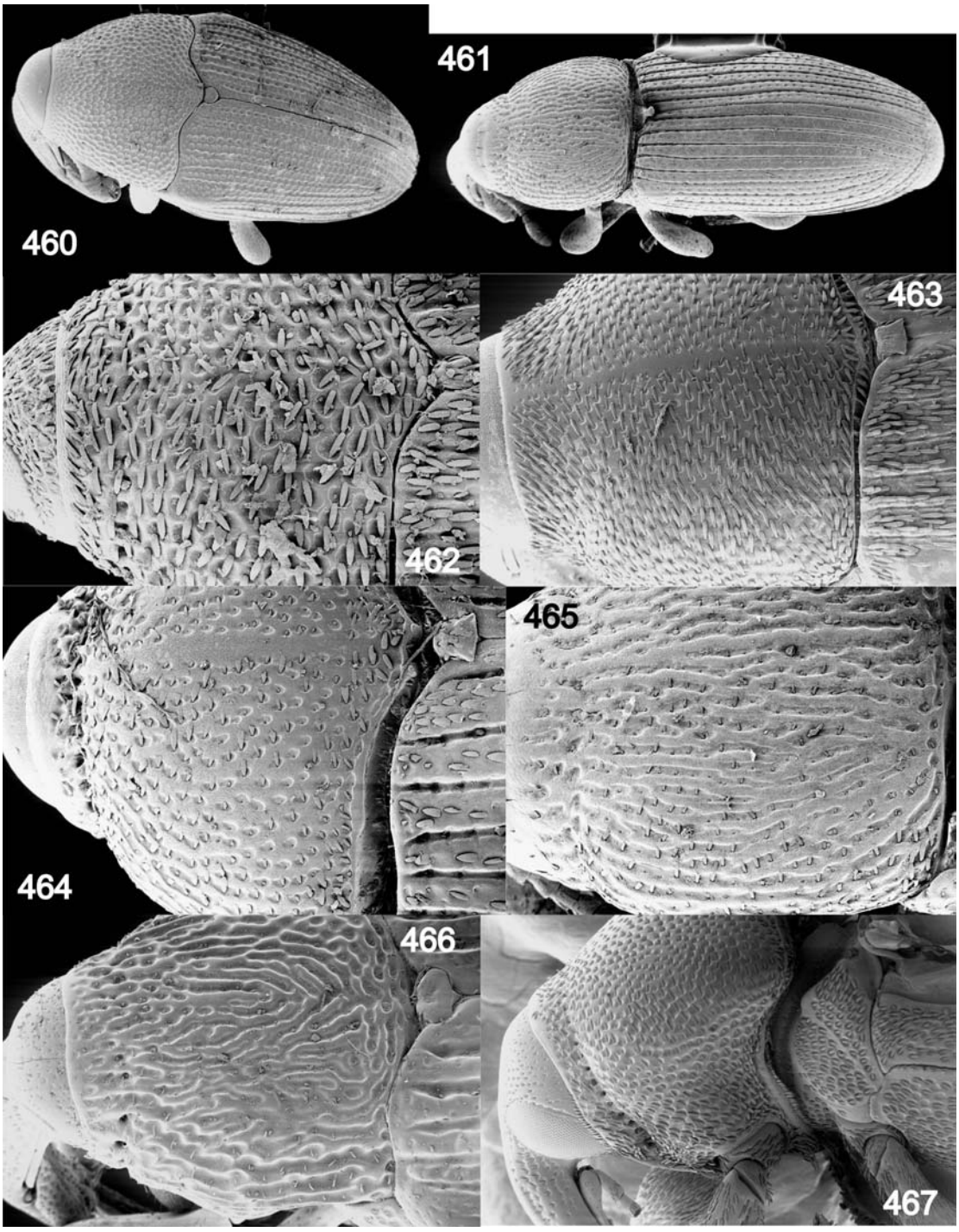
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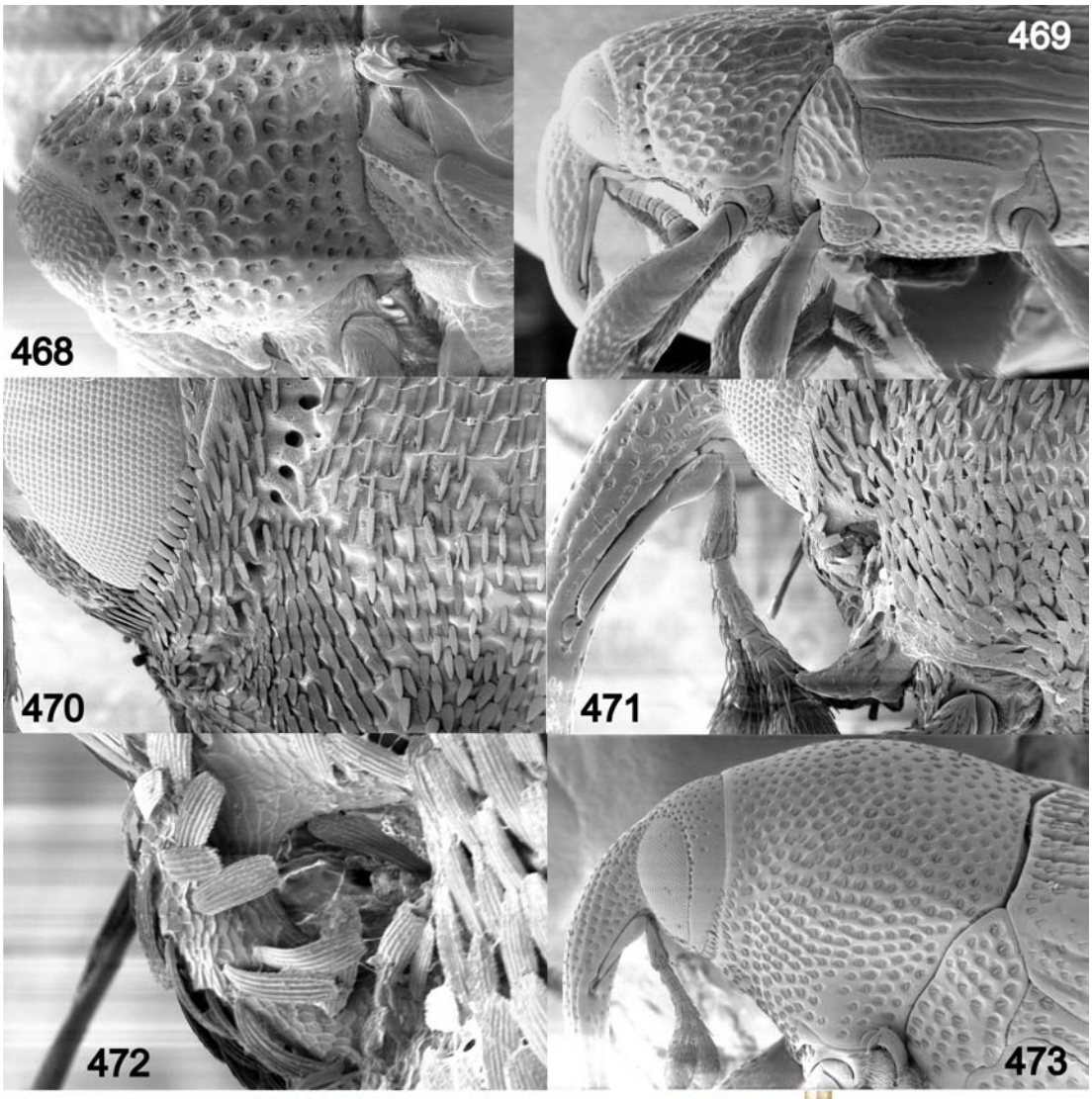
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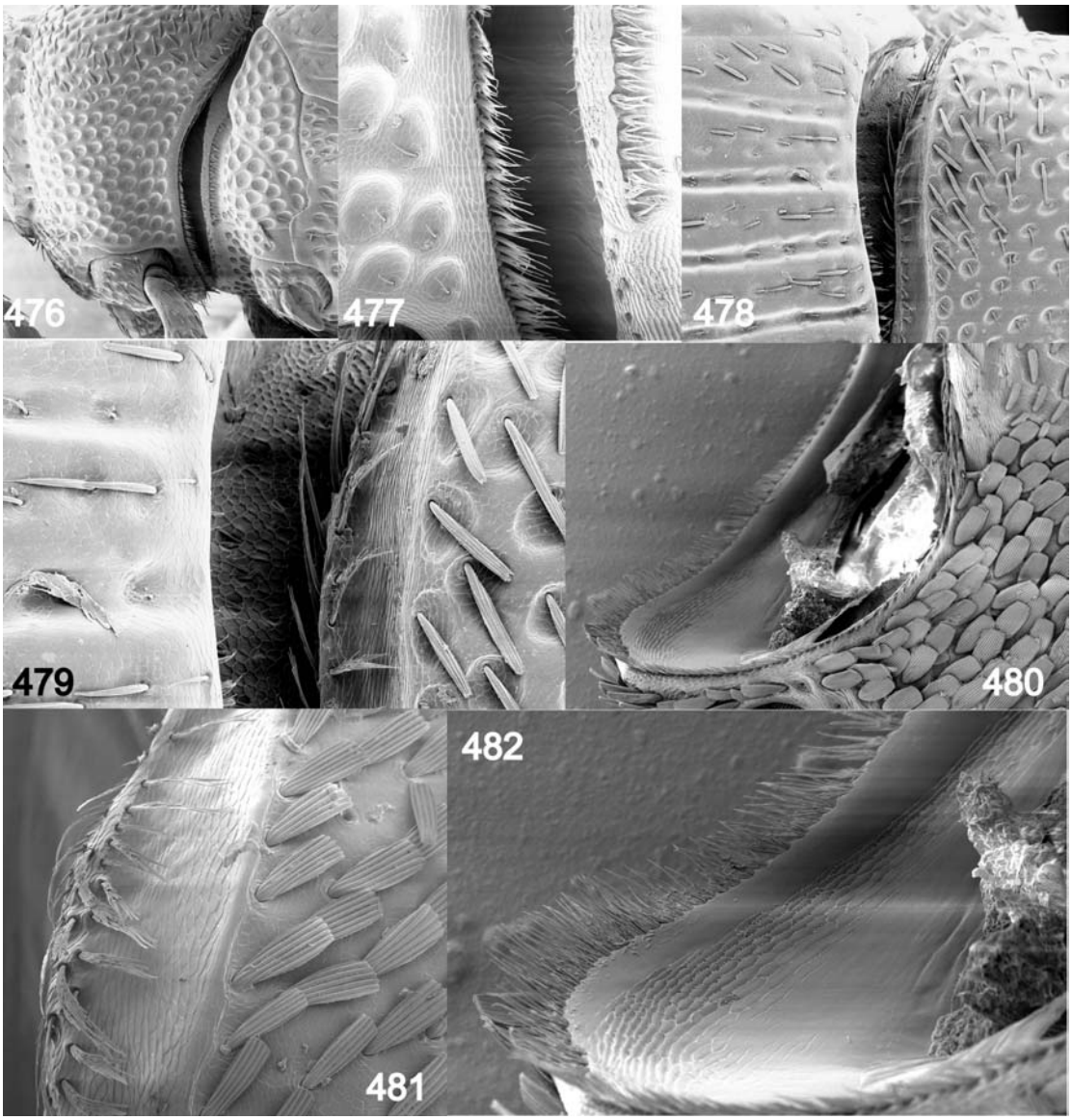
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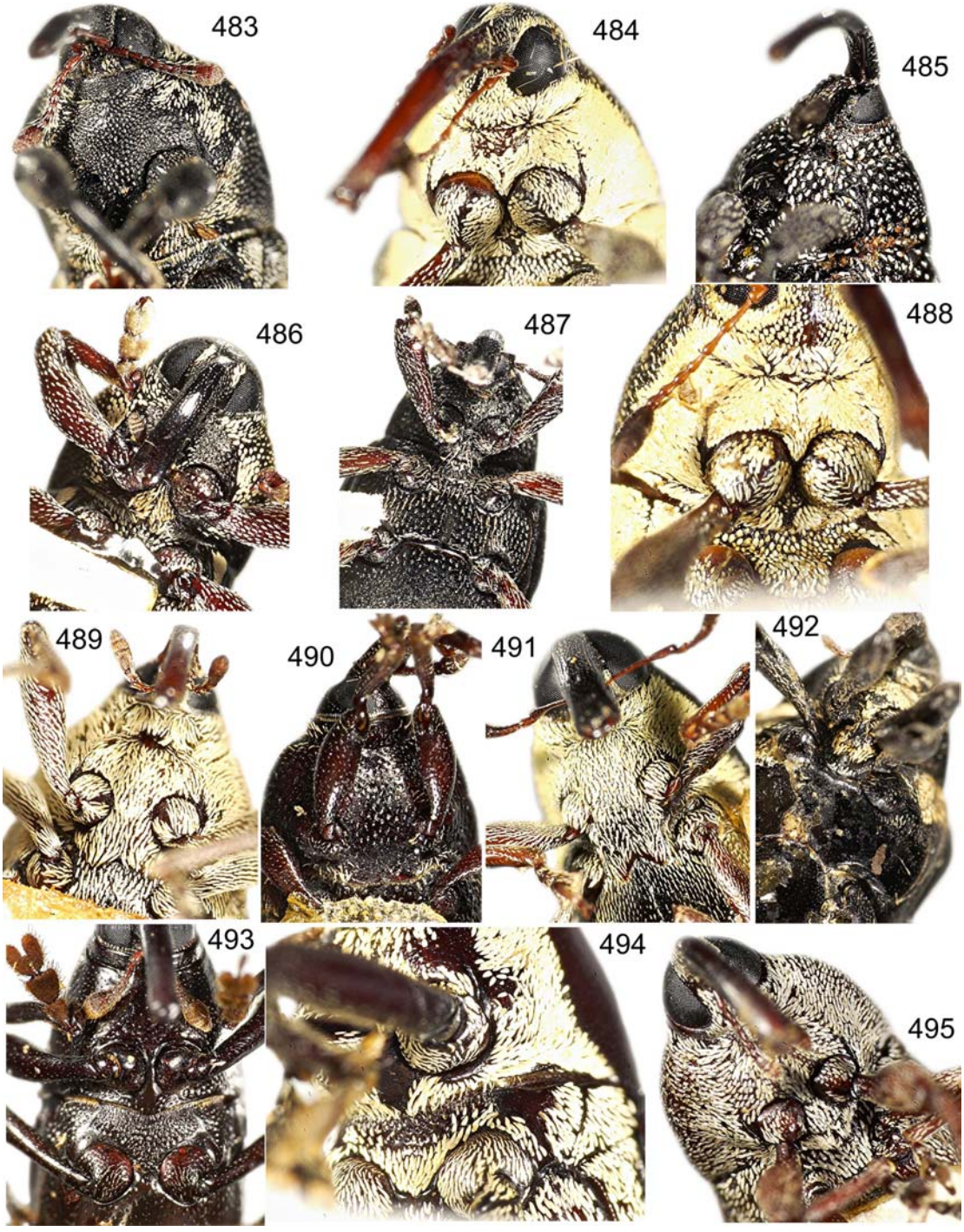
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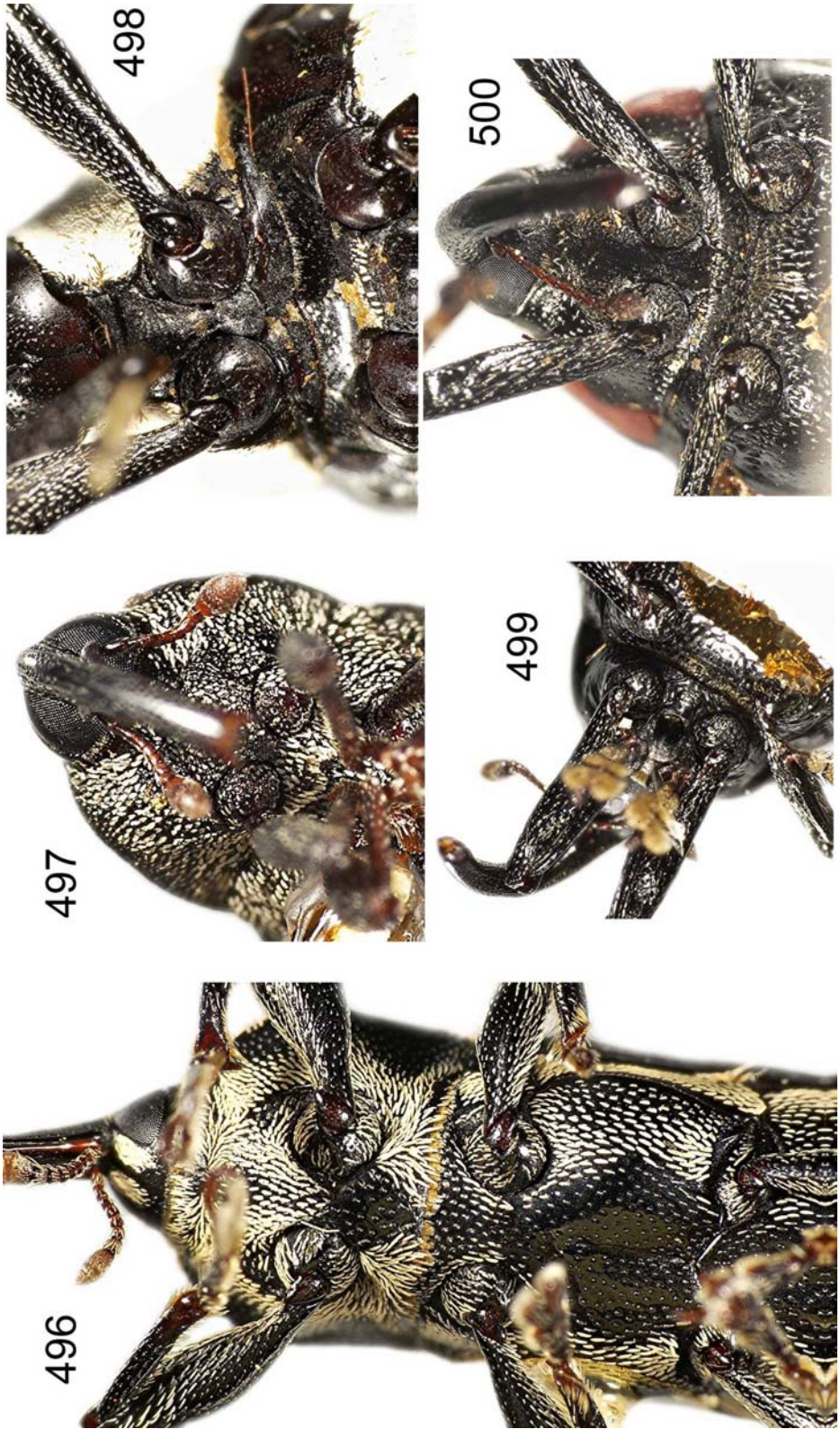
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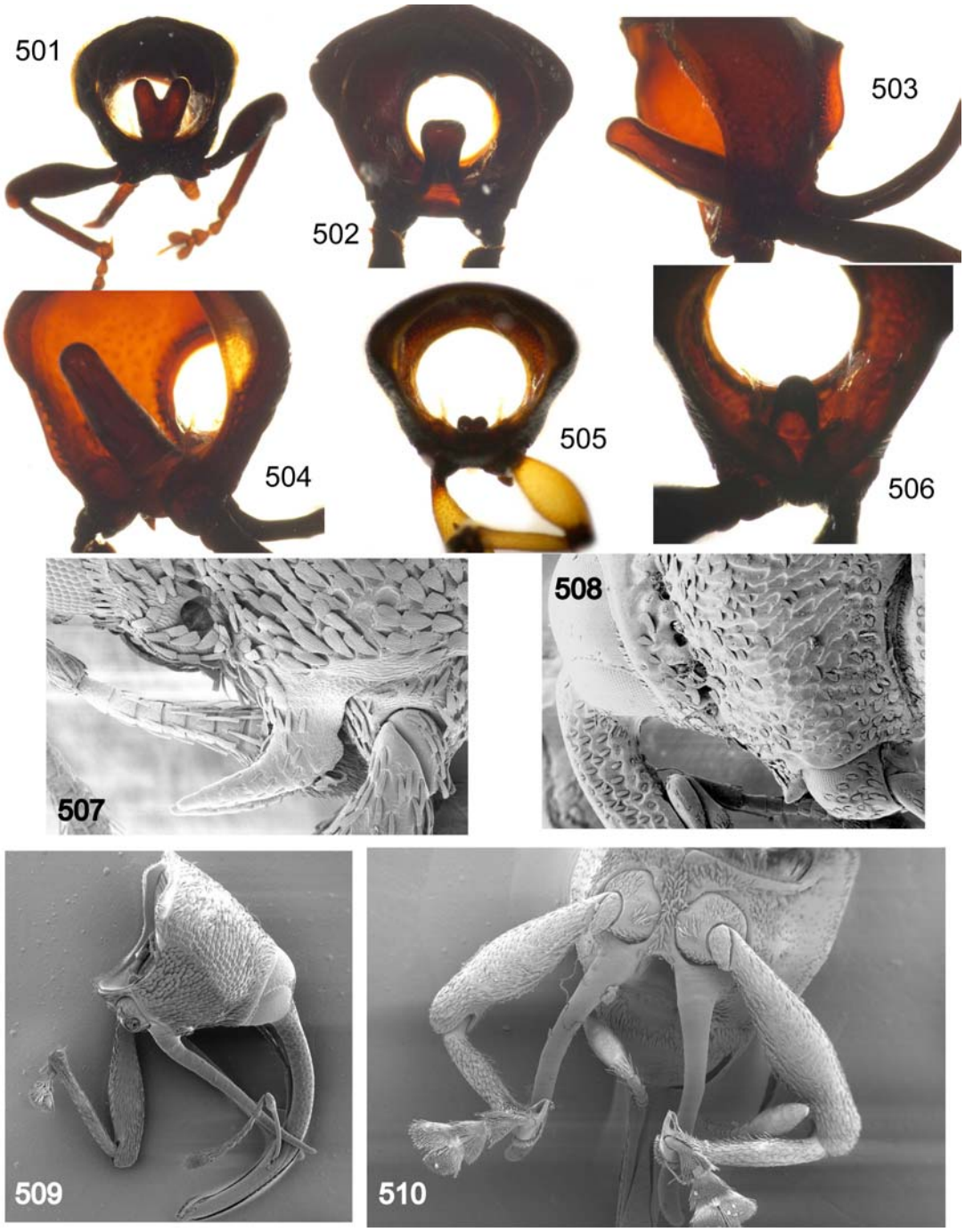
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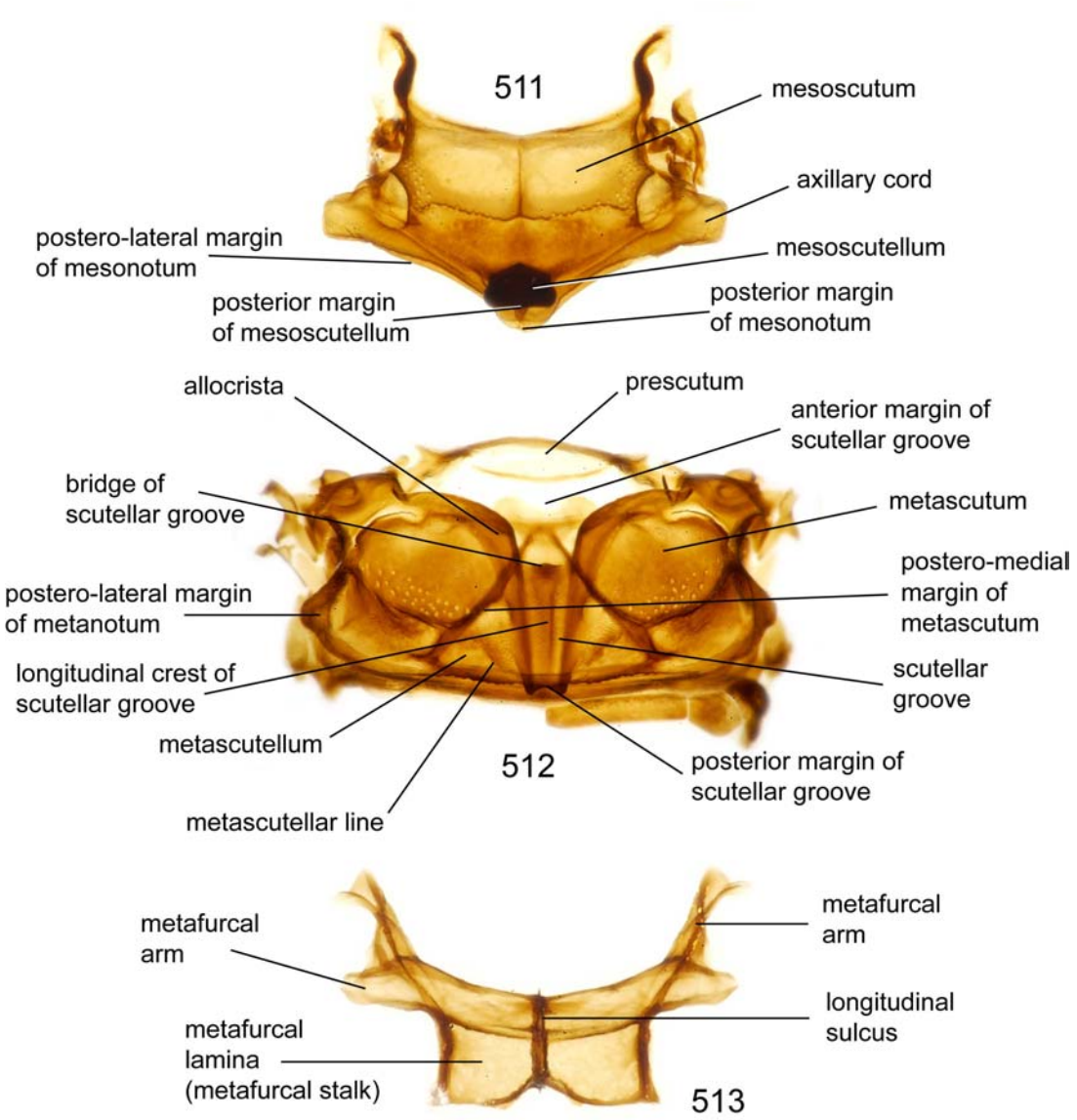
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prescutum
anterior margin of
scutellar groove
bridge of
scutellar groove
metascutum
postero-medial
margin of
metascutum
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of metanotum
longitudinal crest of
scutellar groove
scutellar
groove
metascutellum
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posterior margin of
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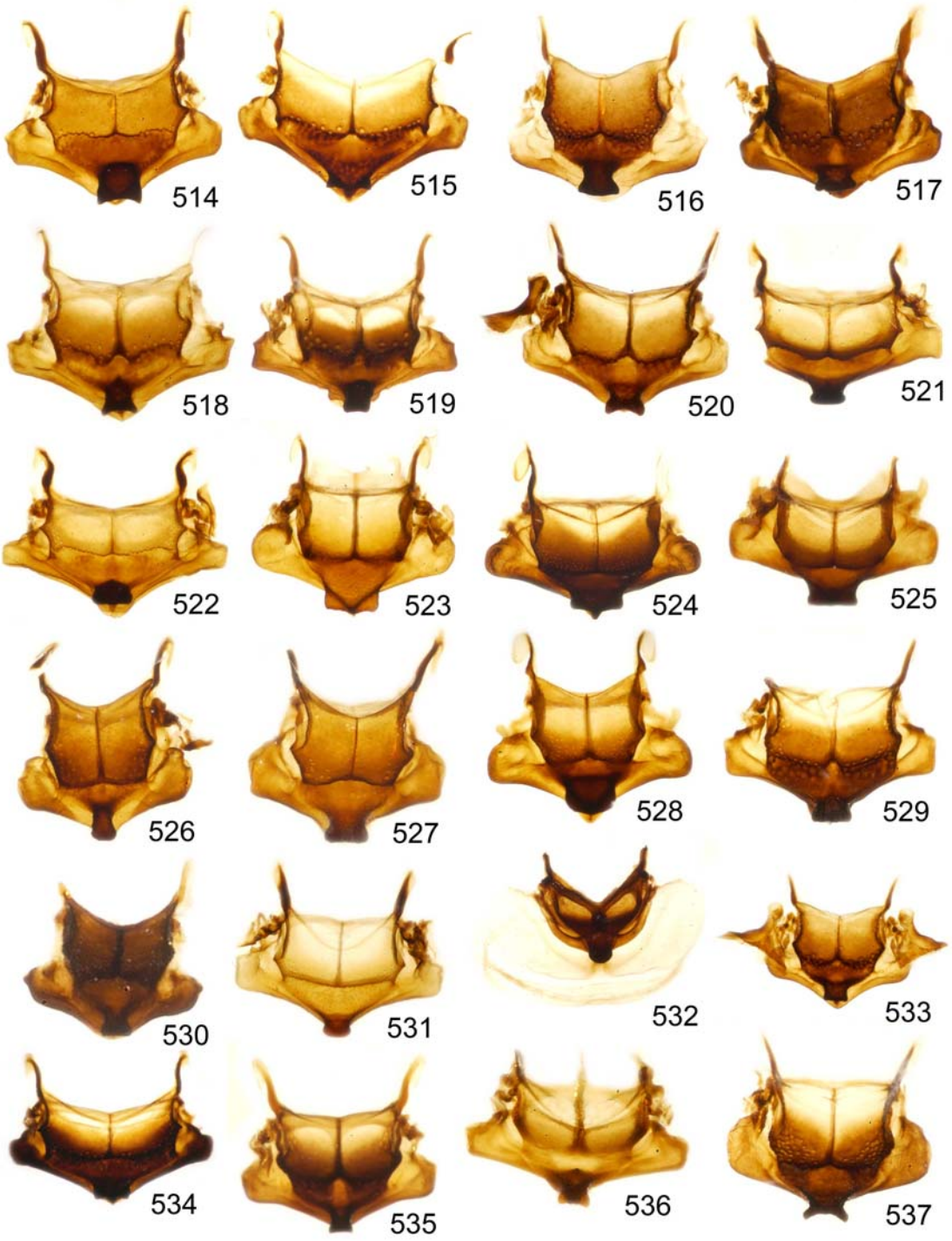
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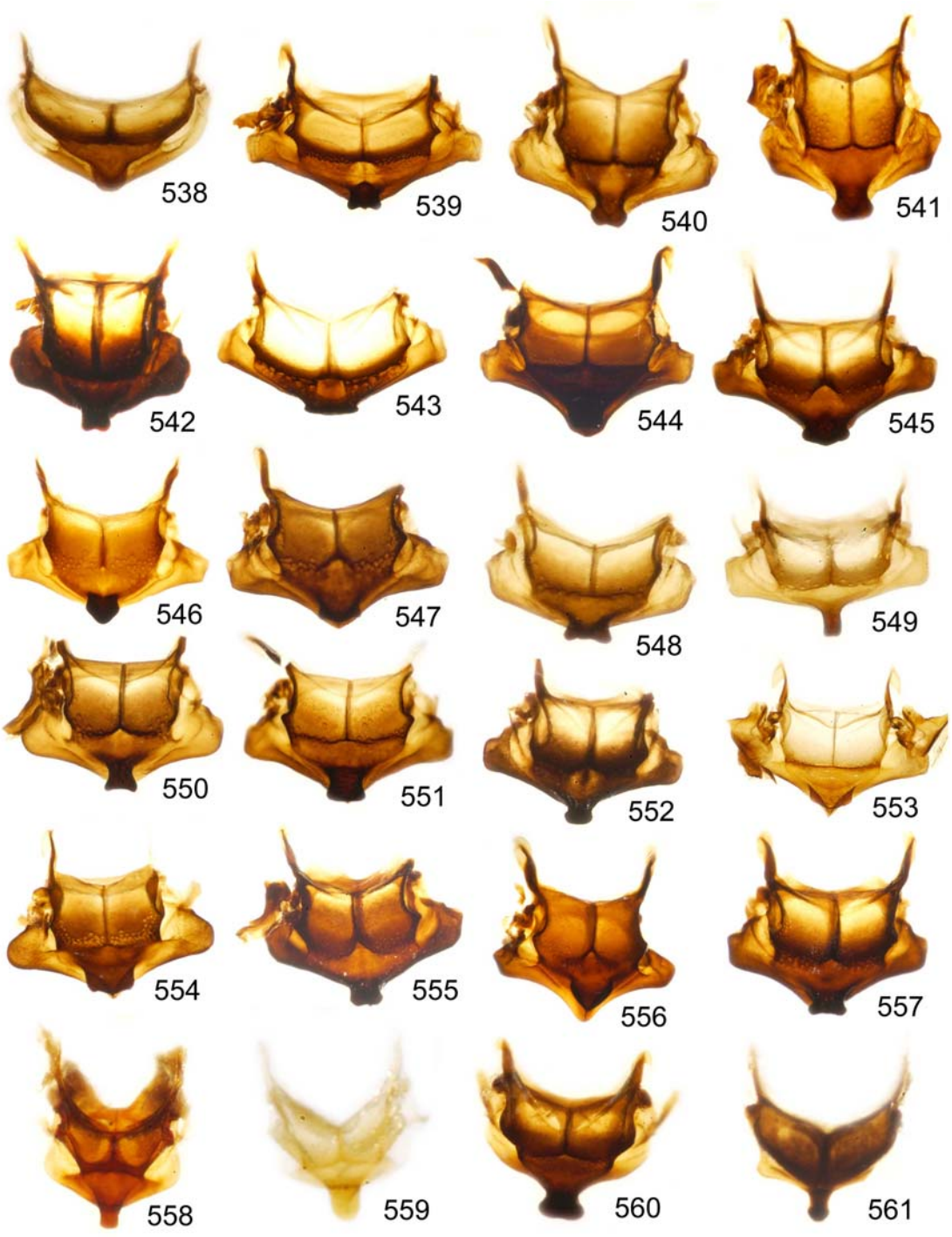
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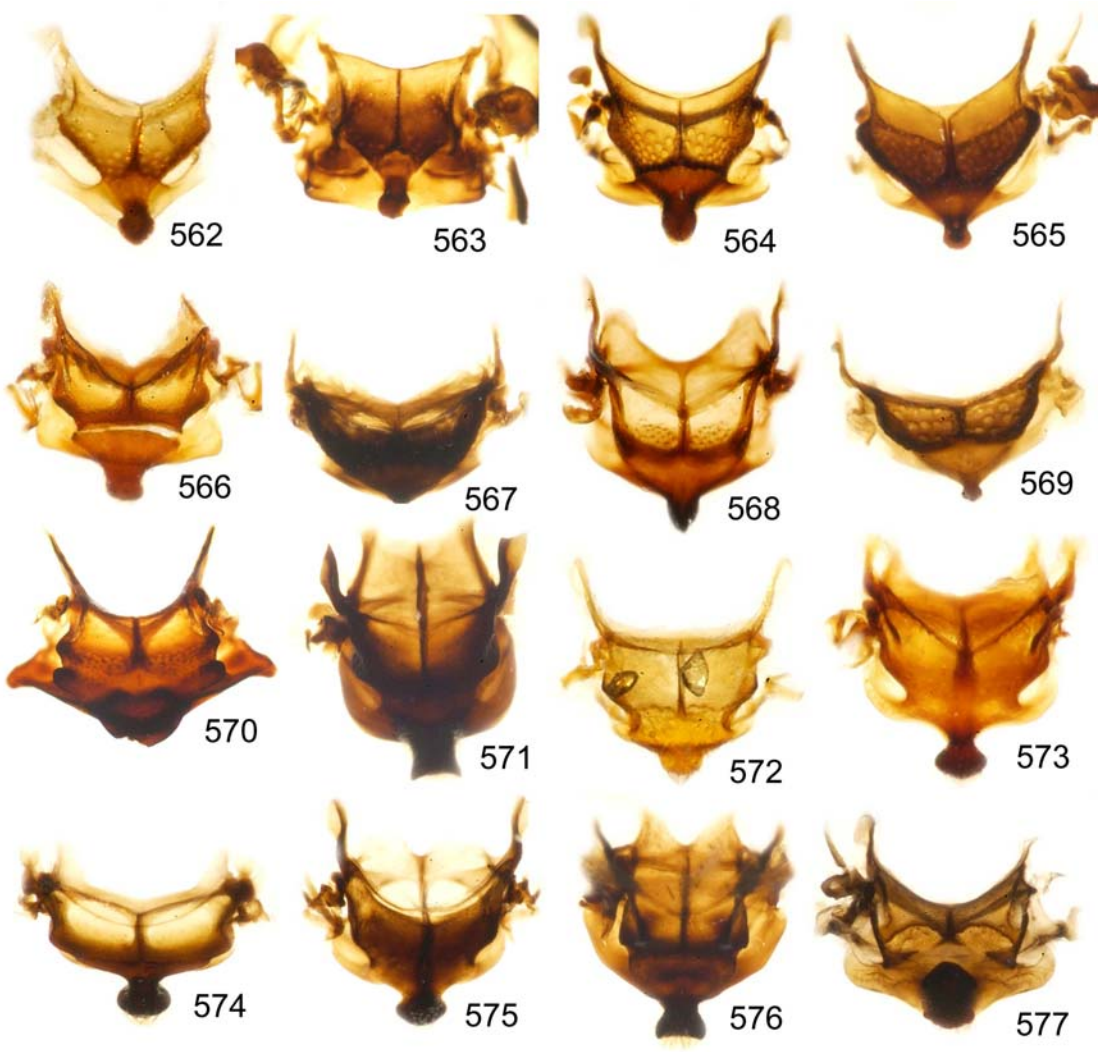
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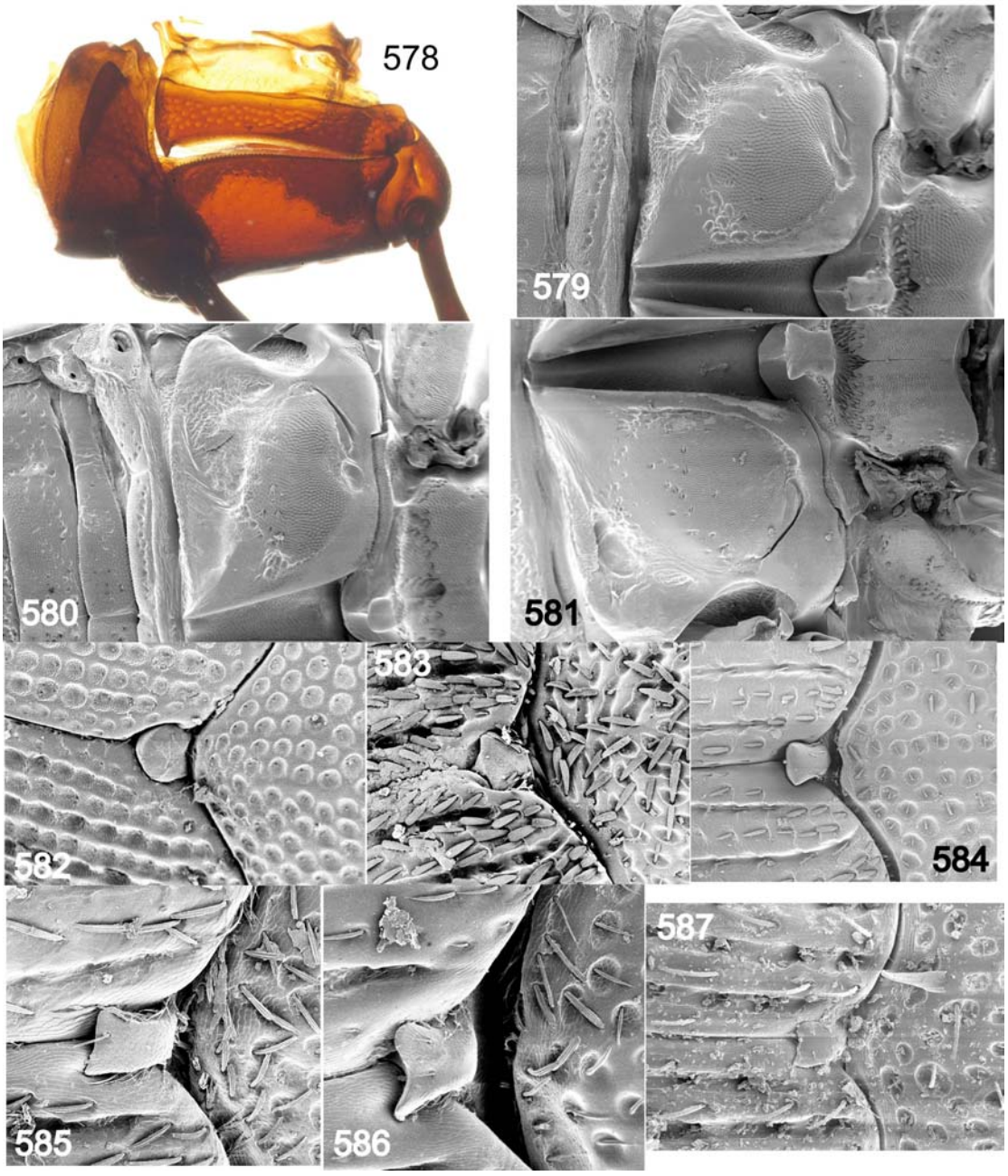
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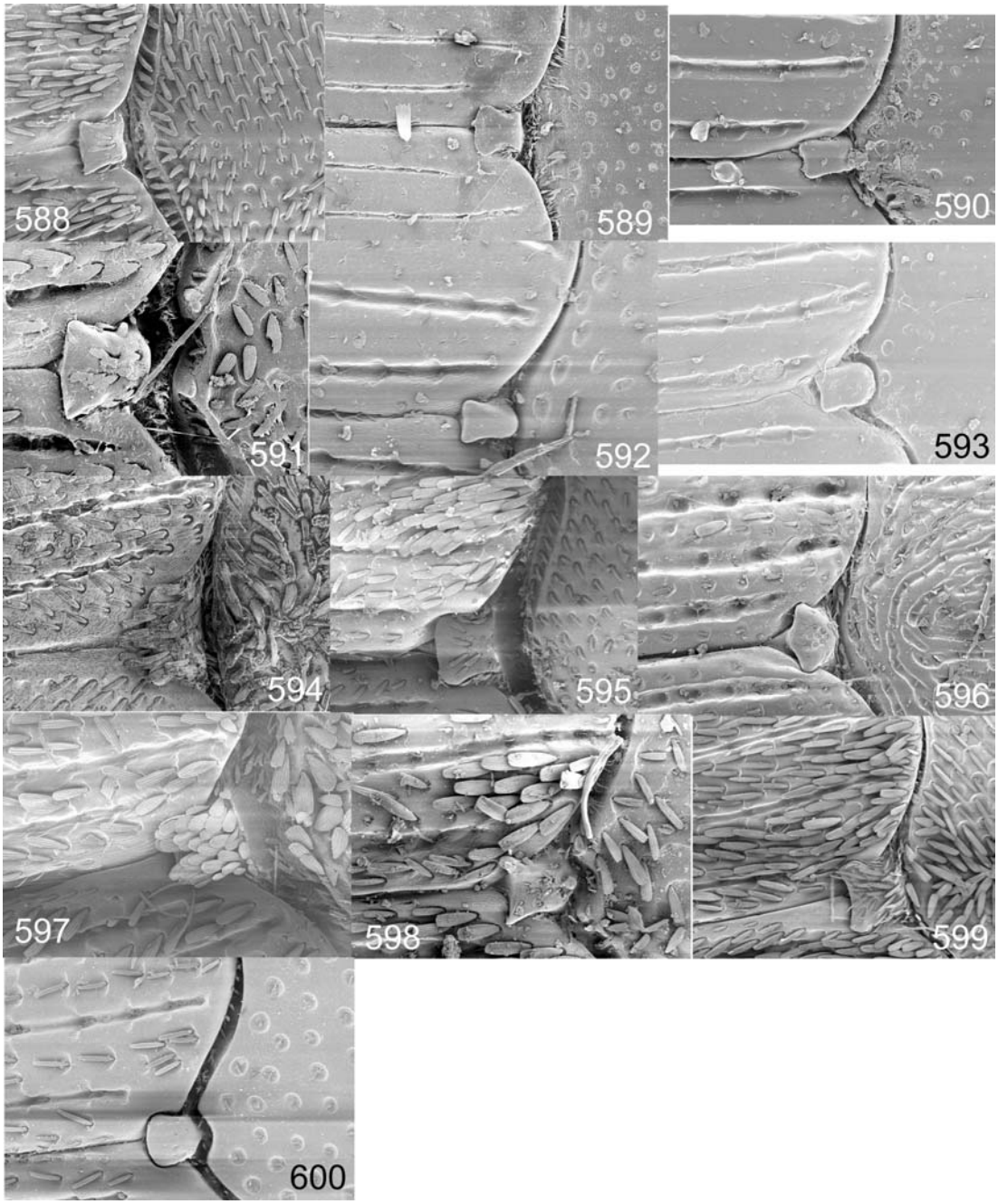
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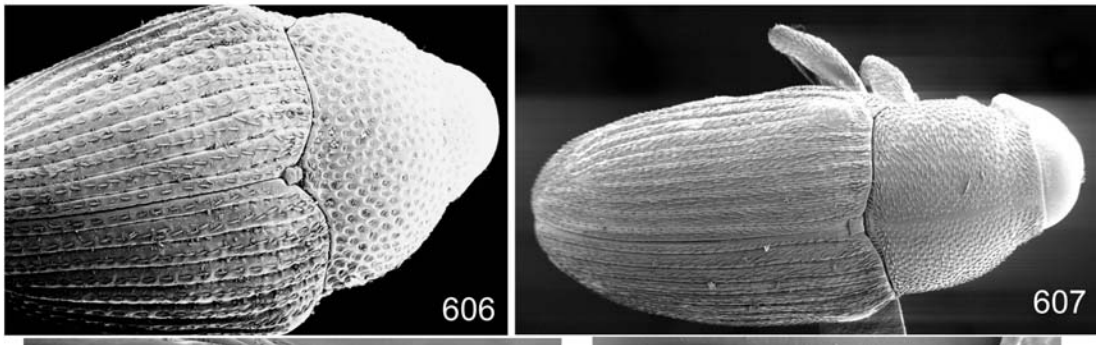
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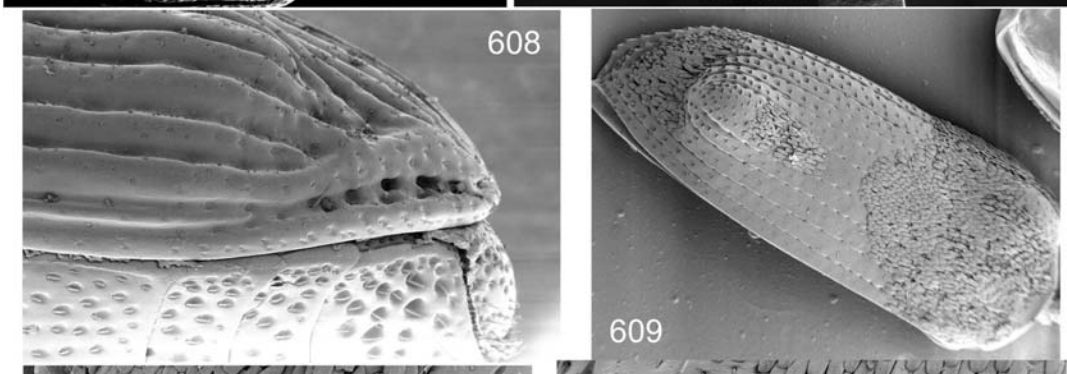
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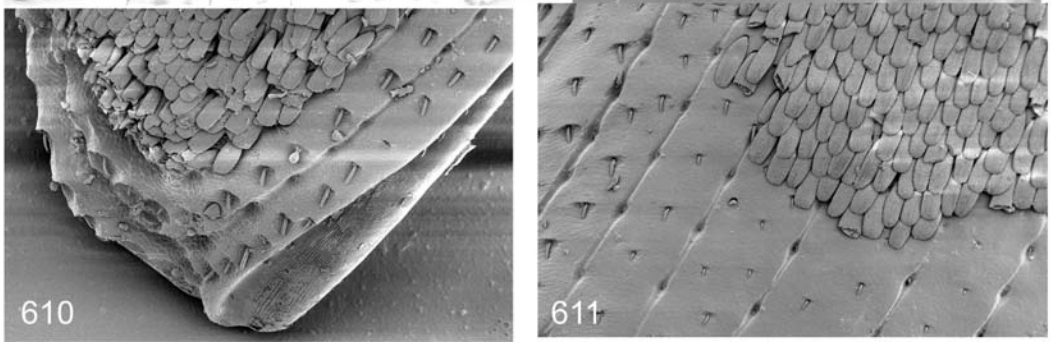
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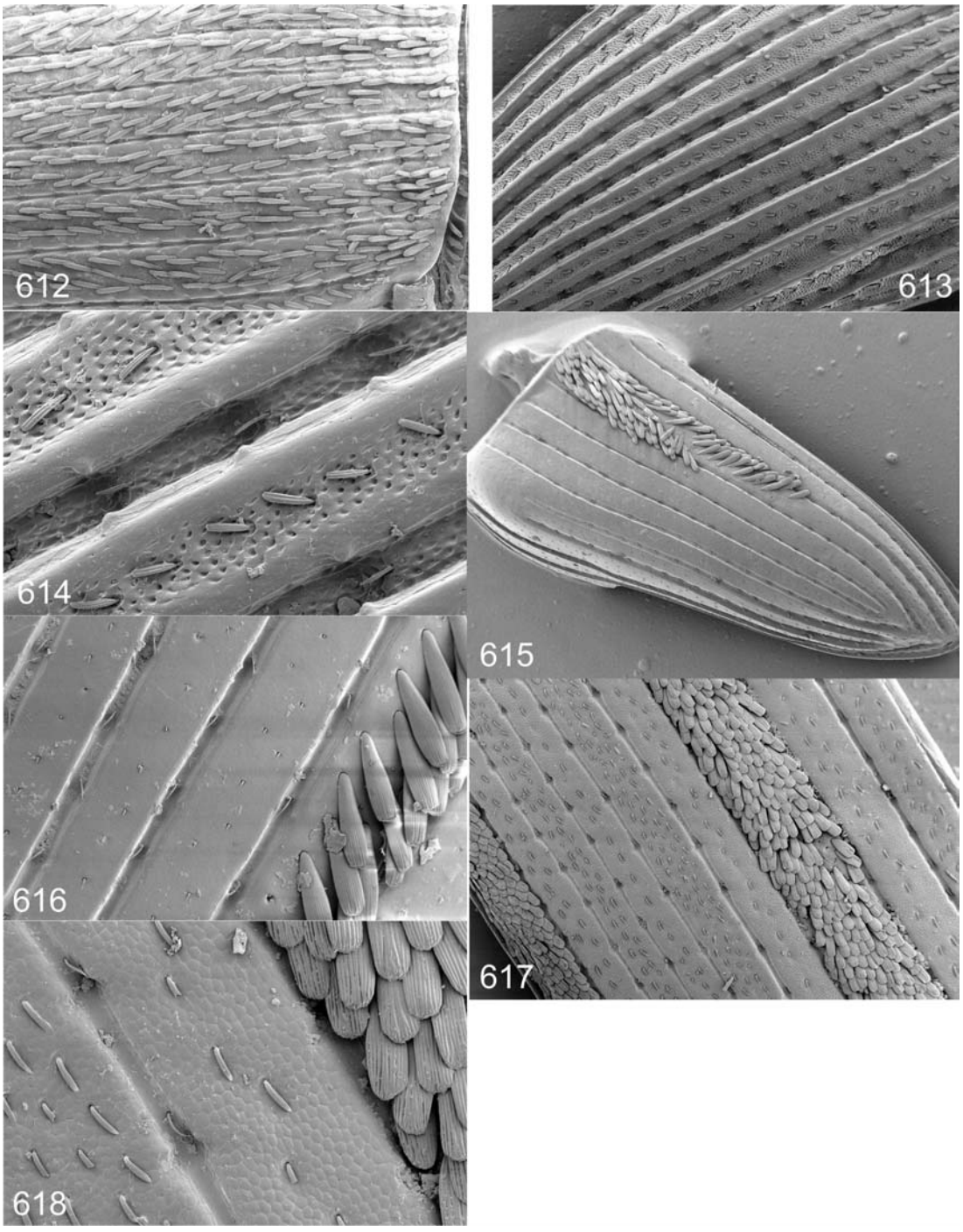
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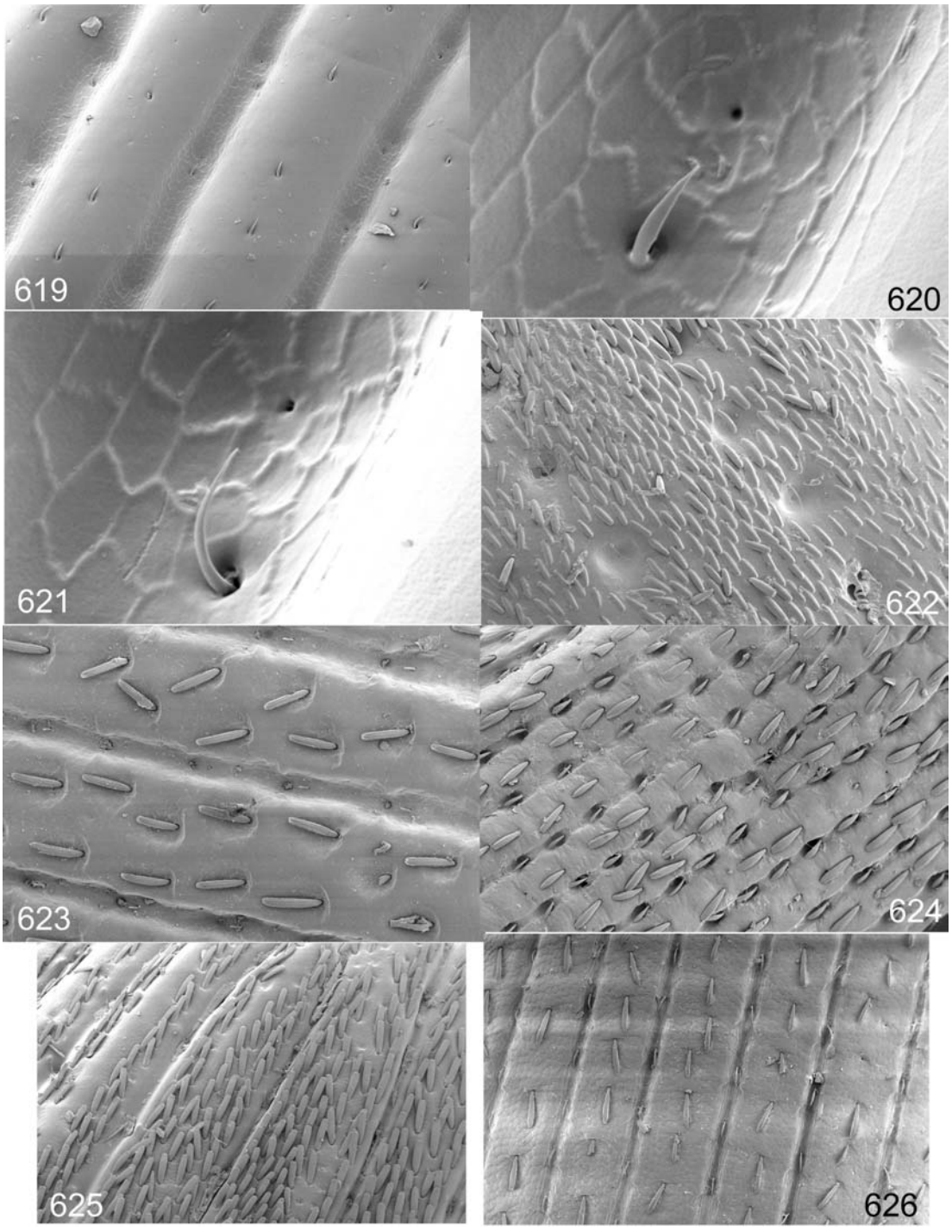
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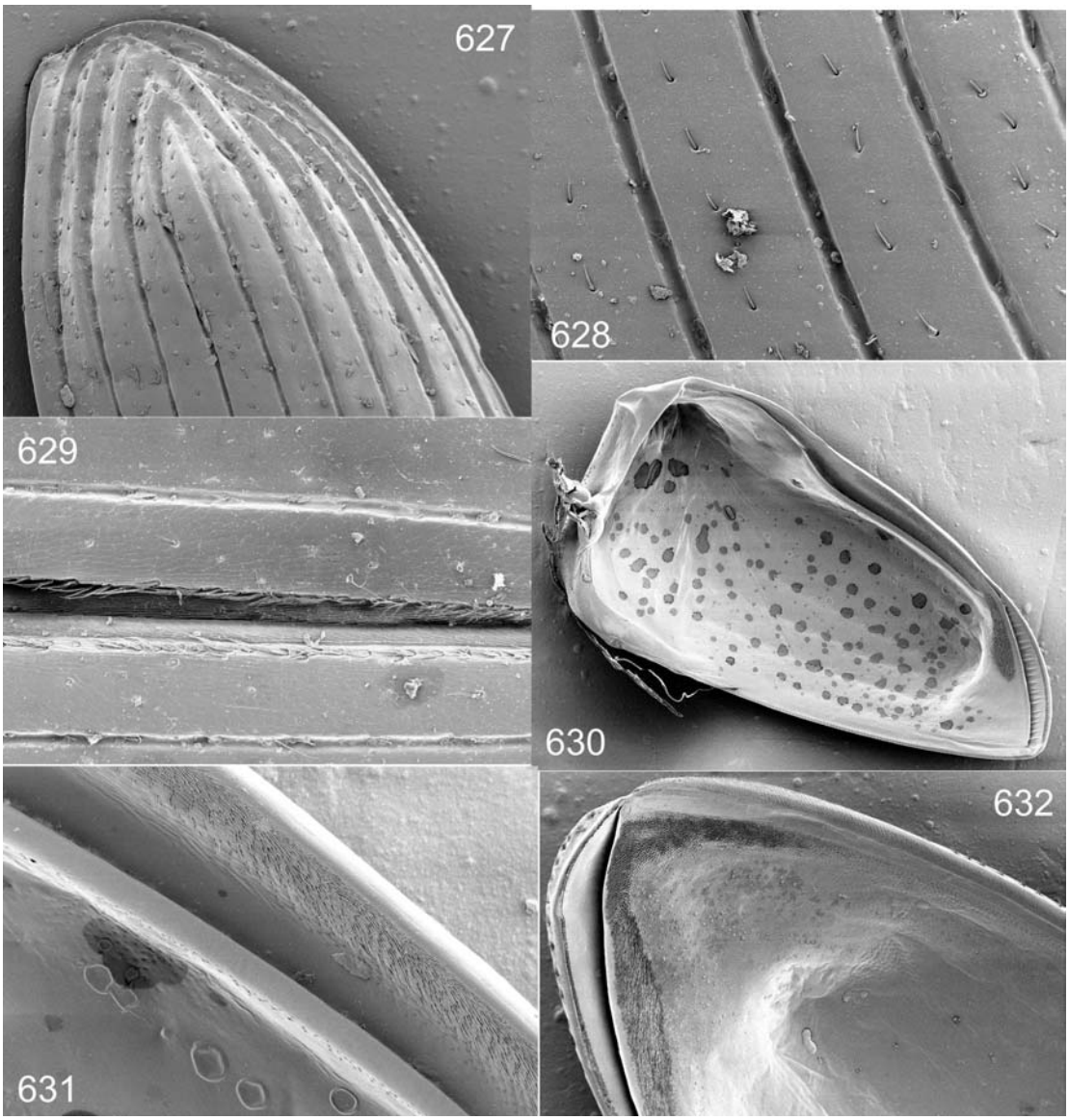
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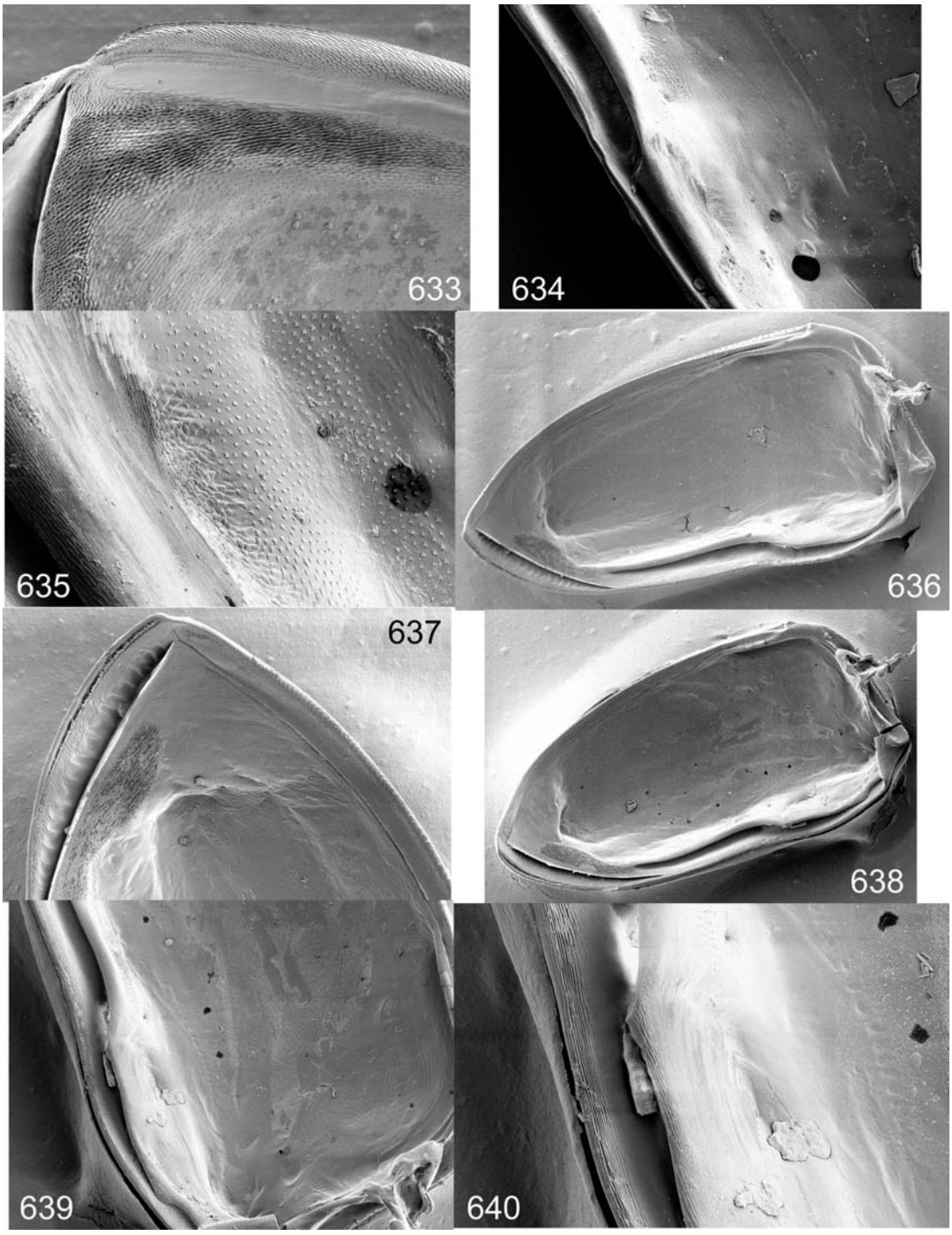
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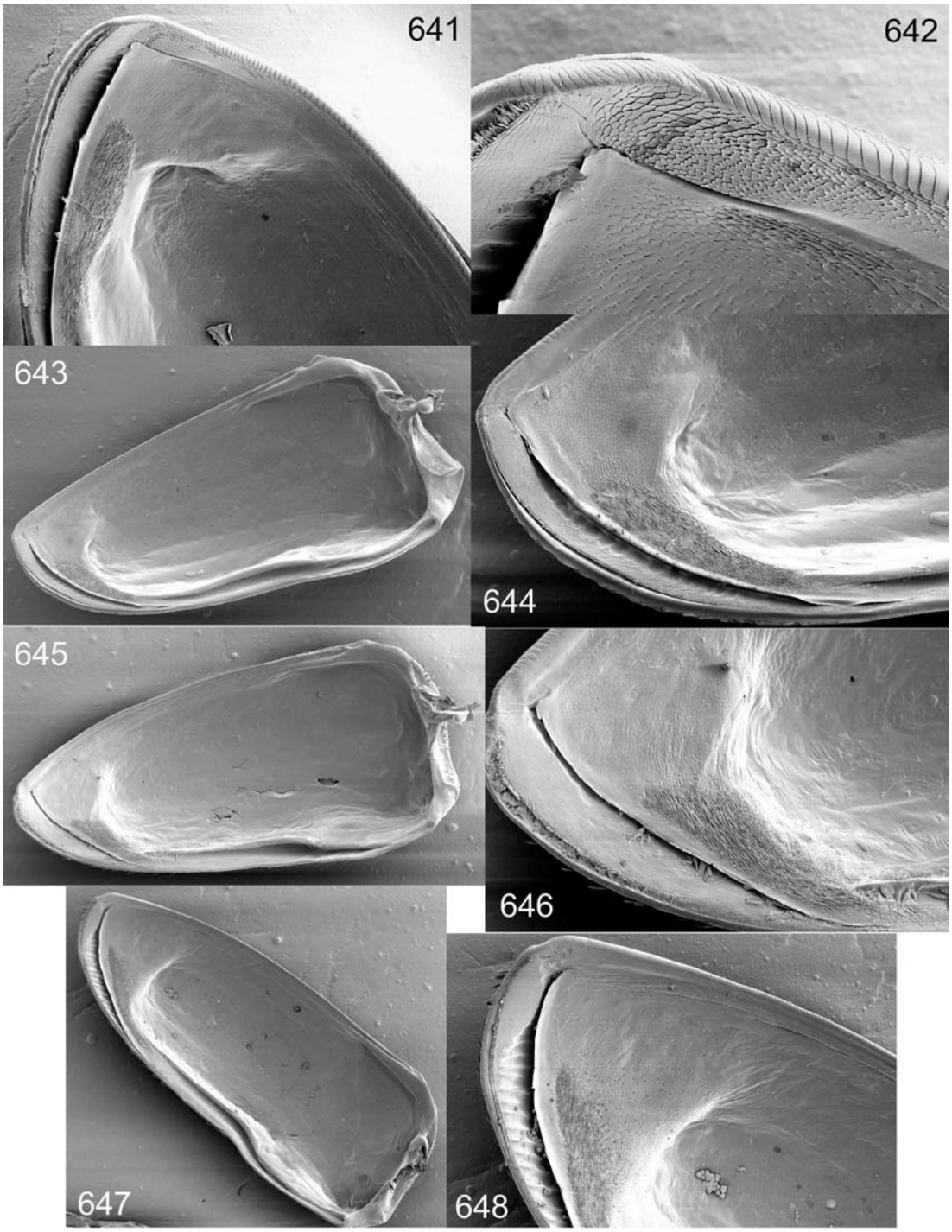
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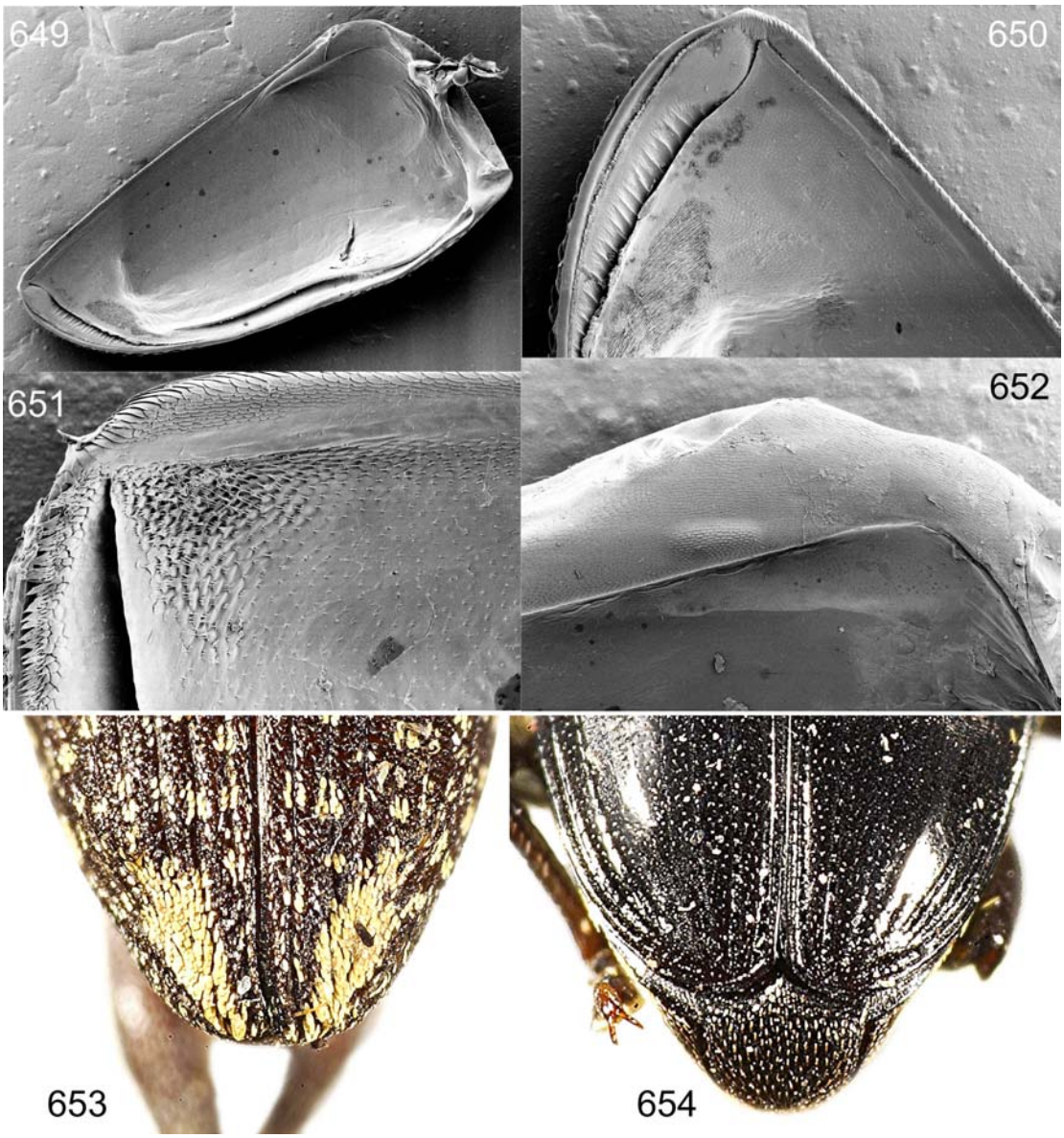
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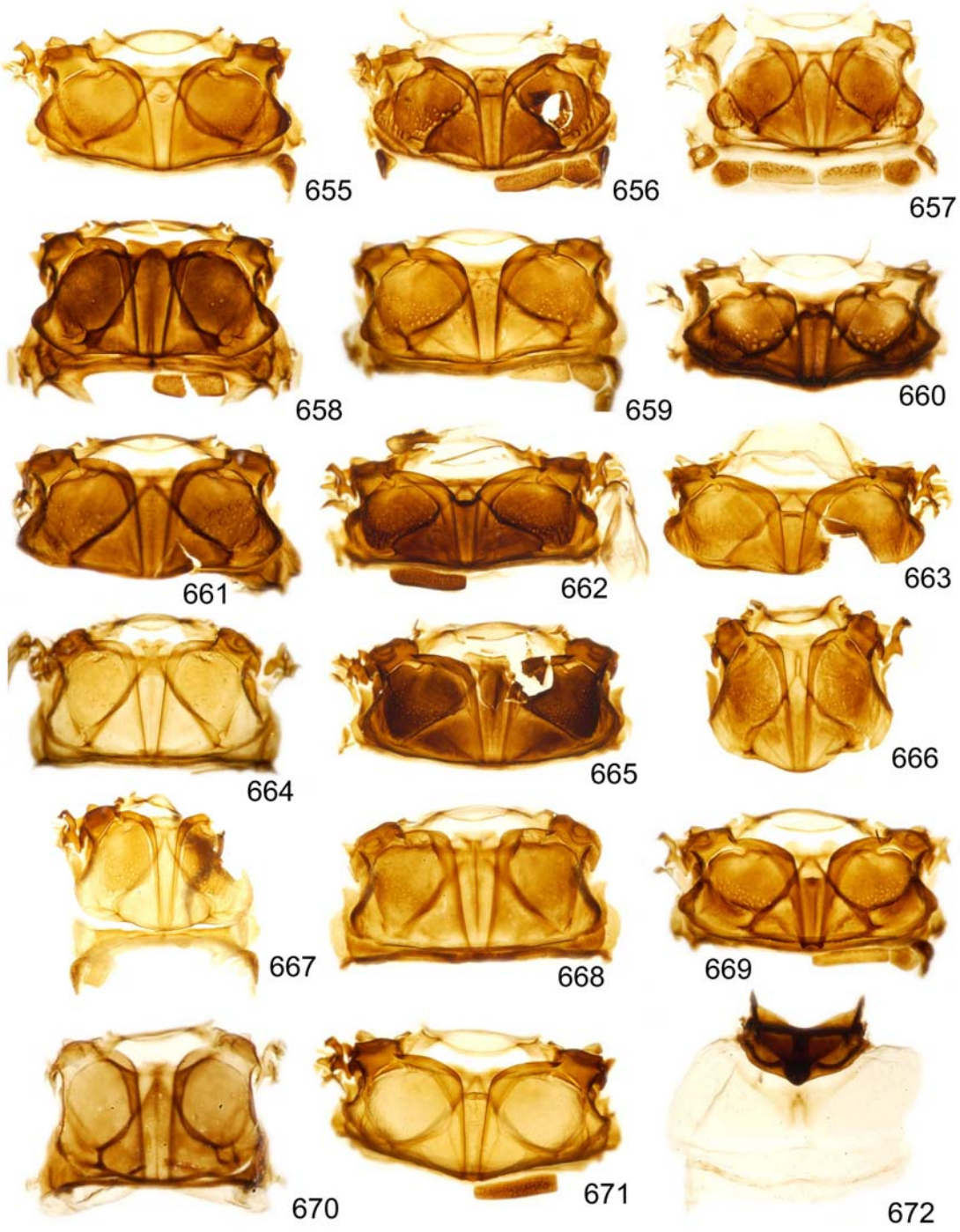
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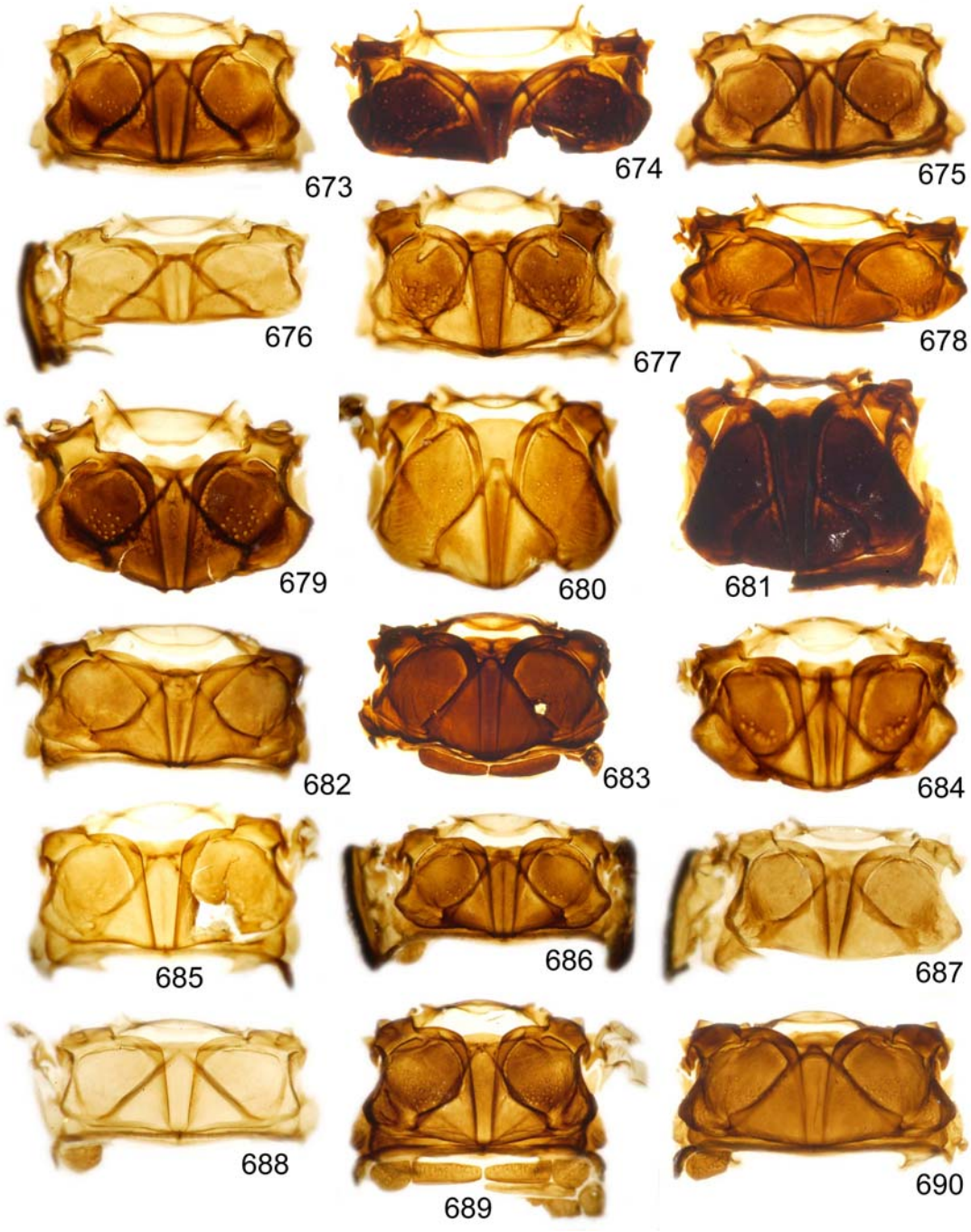
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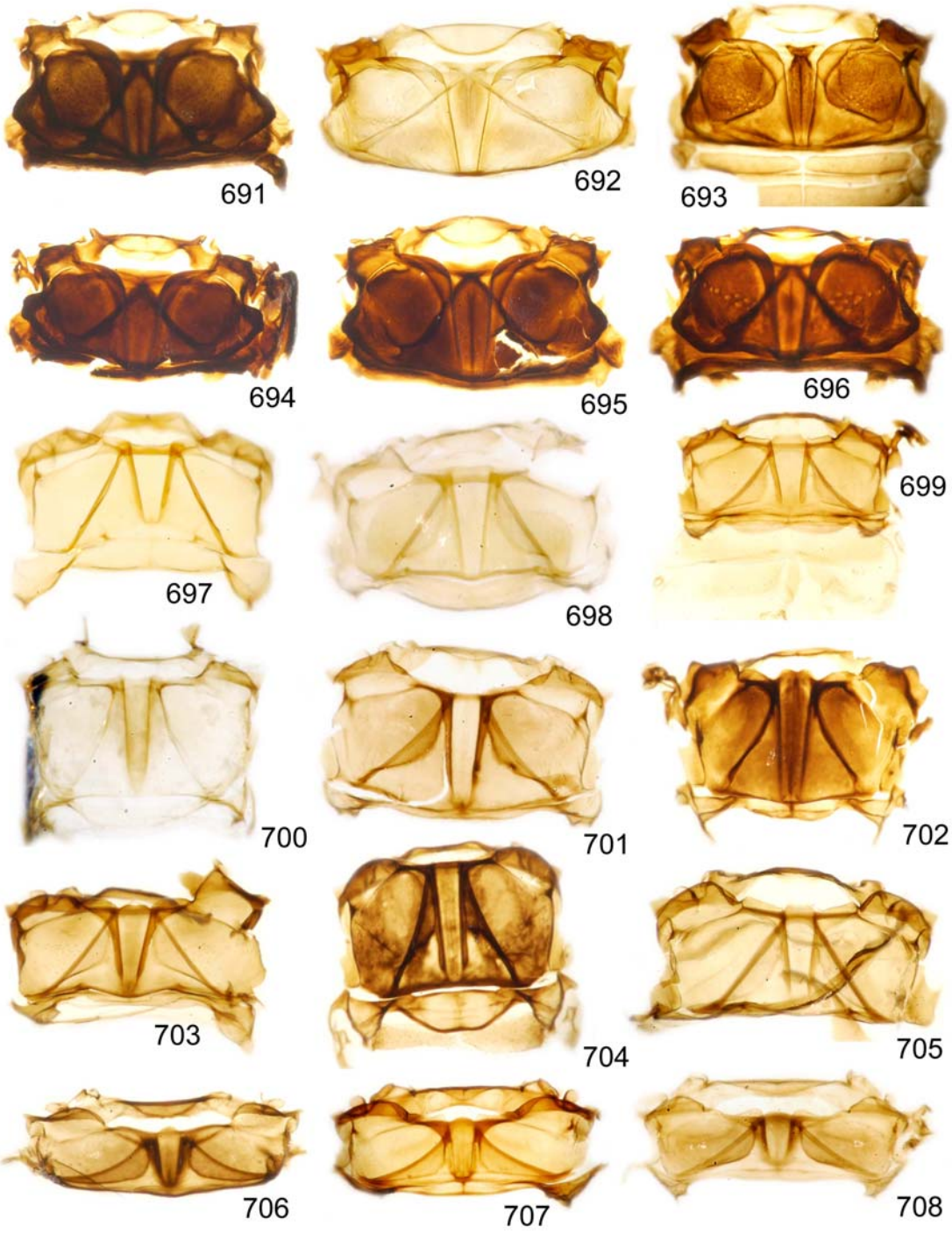
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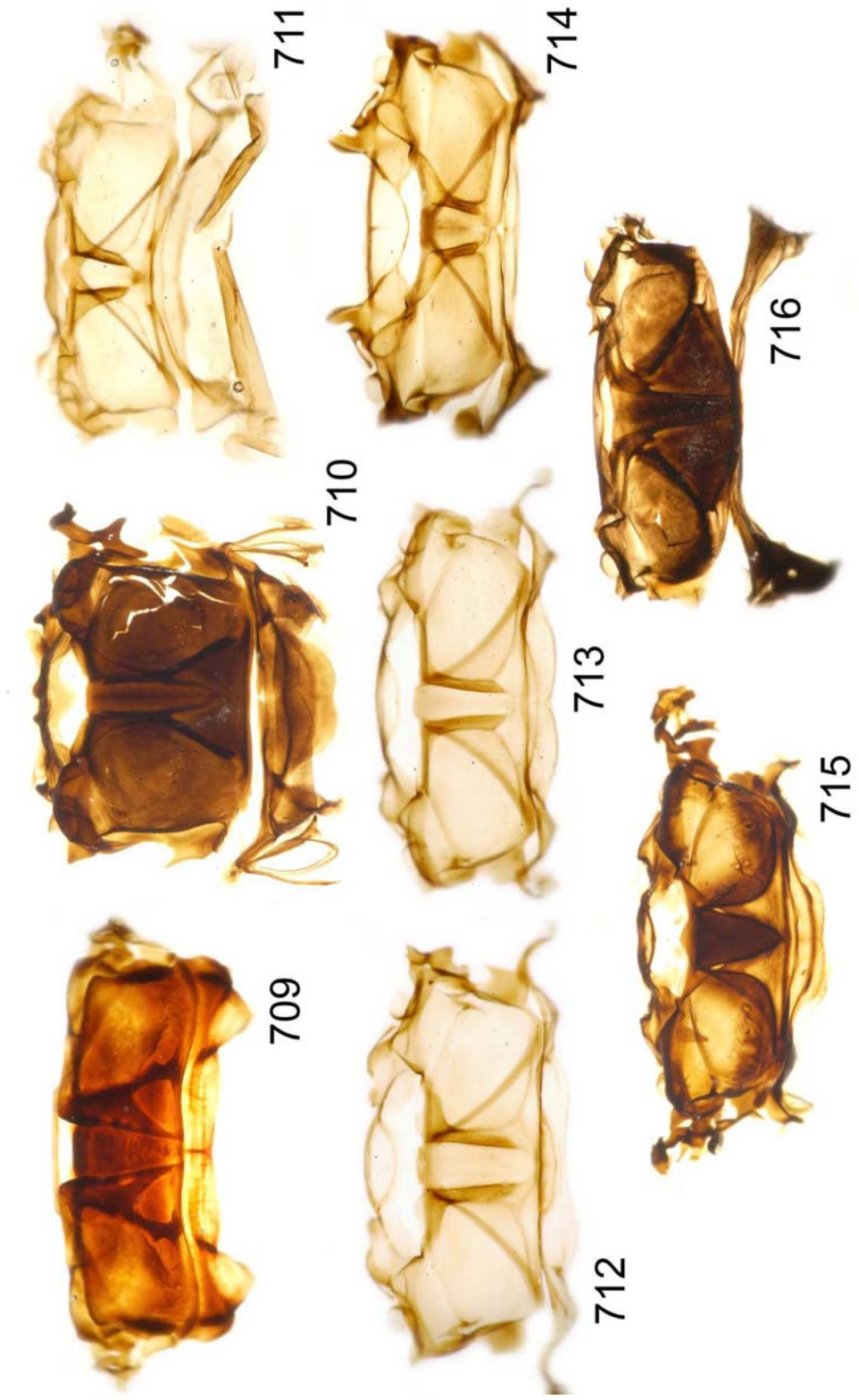
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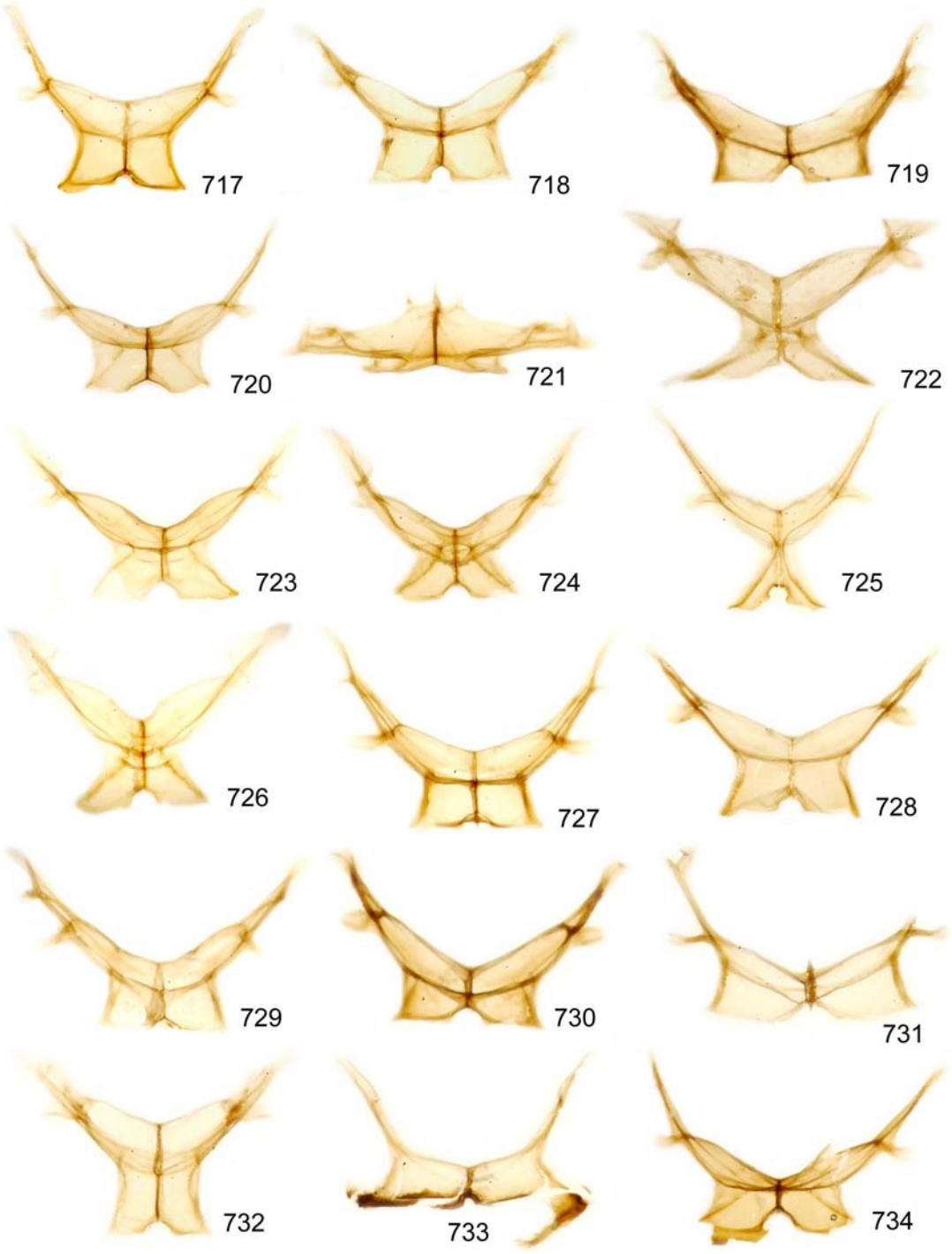
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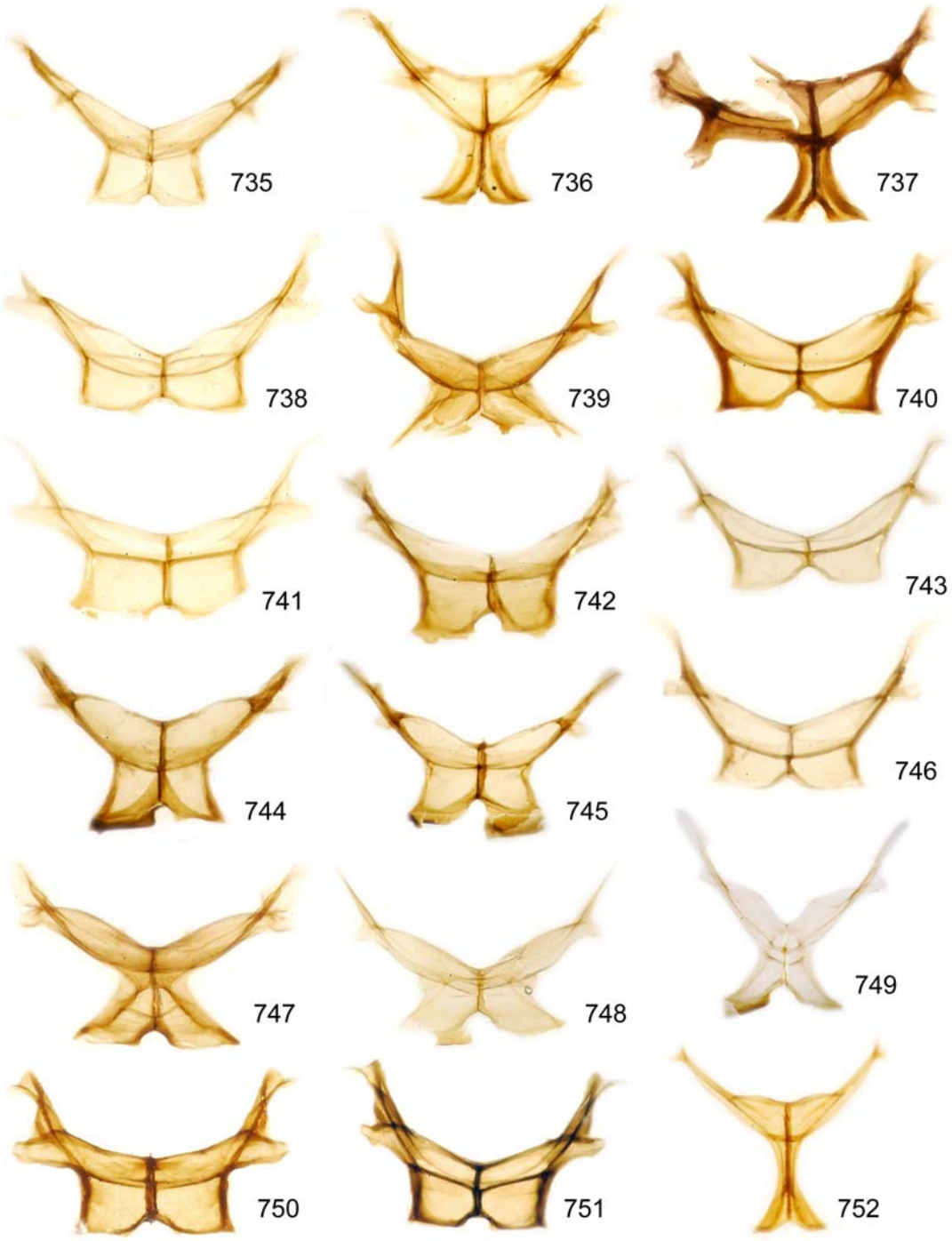
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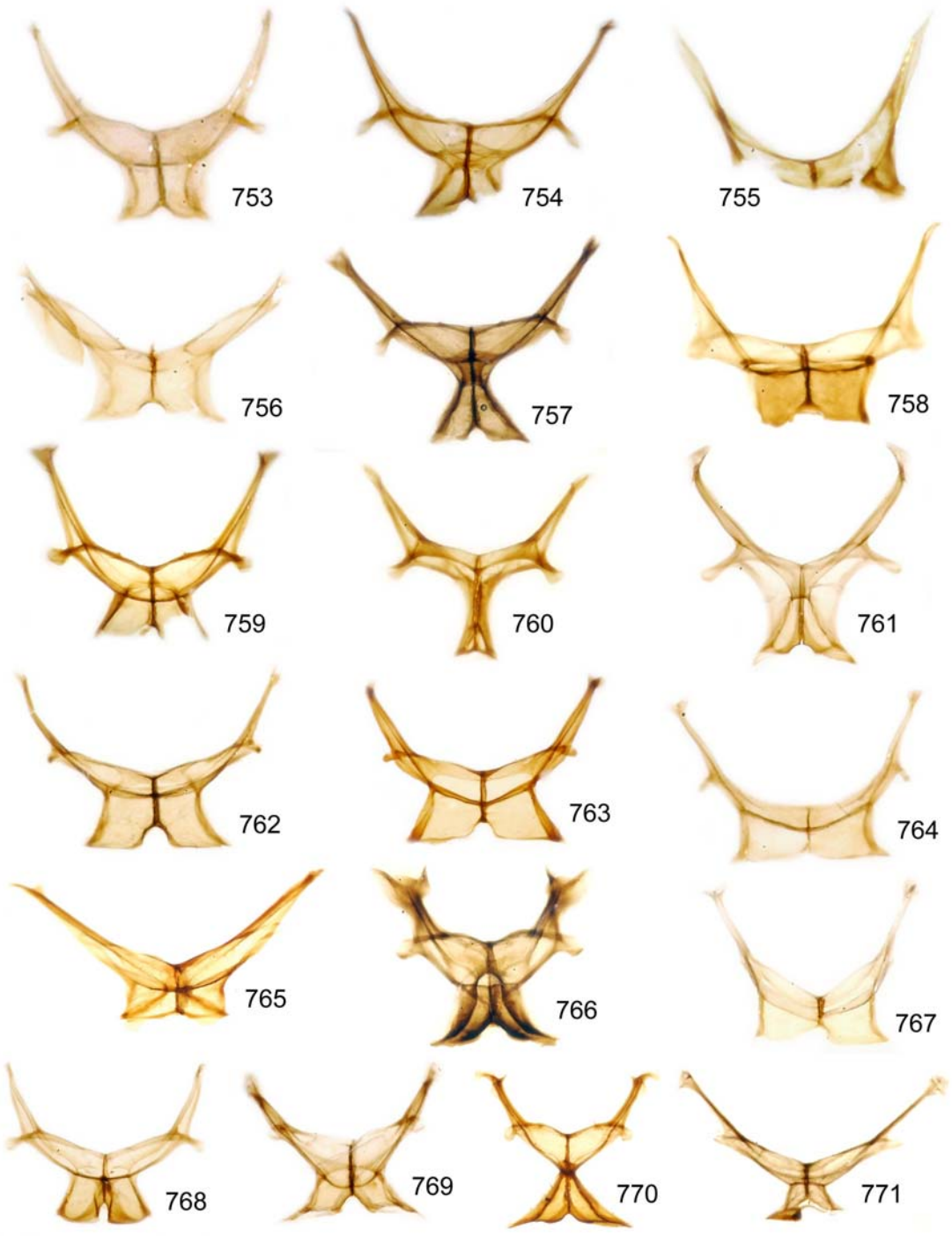
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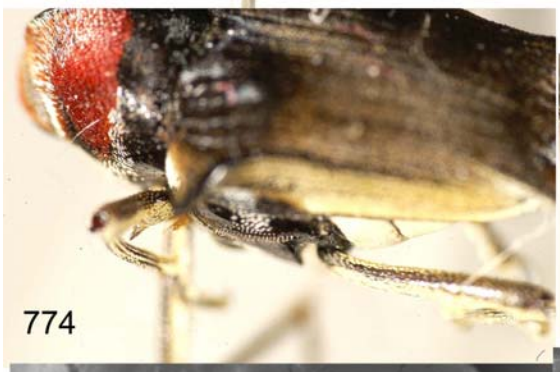

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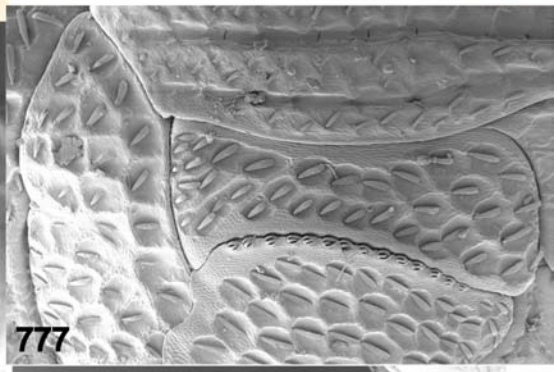

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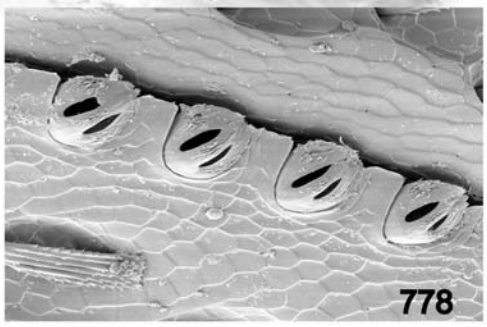

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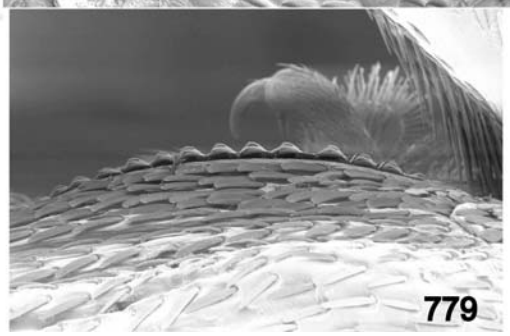

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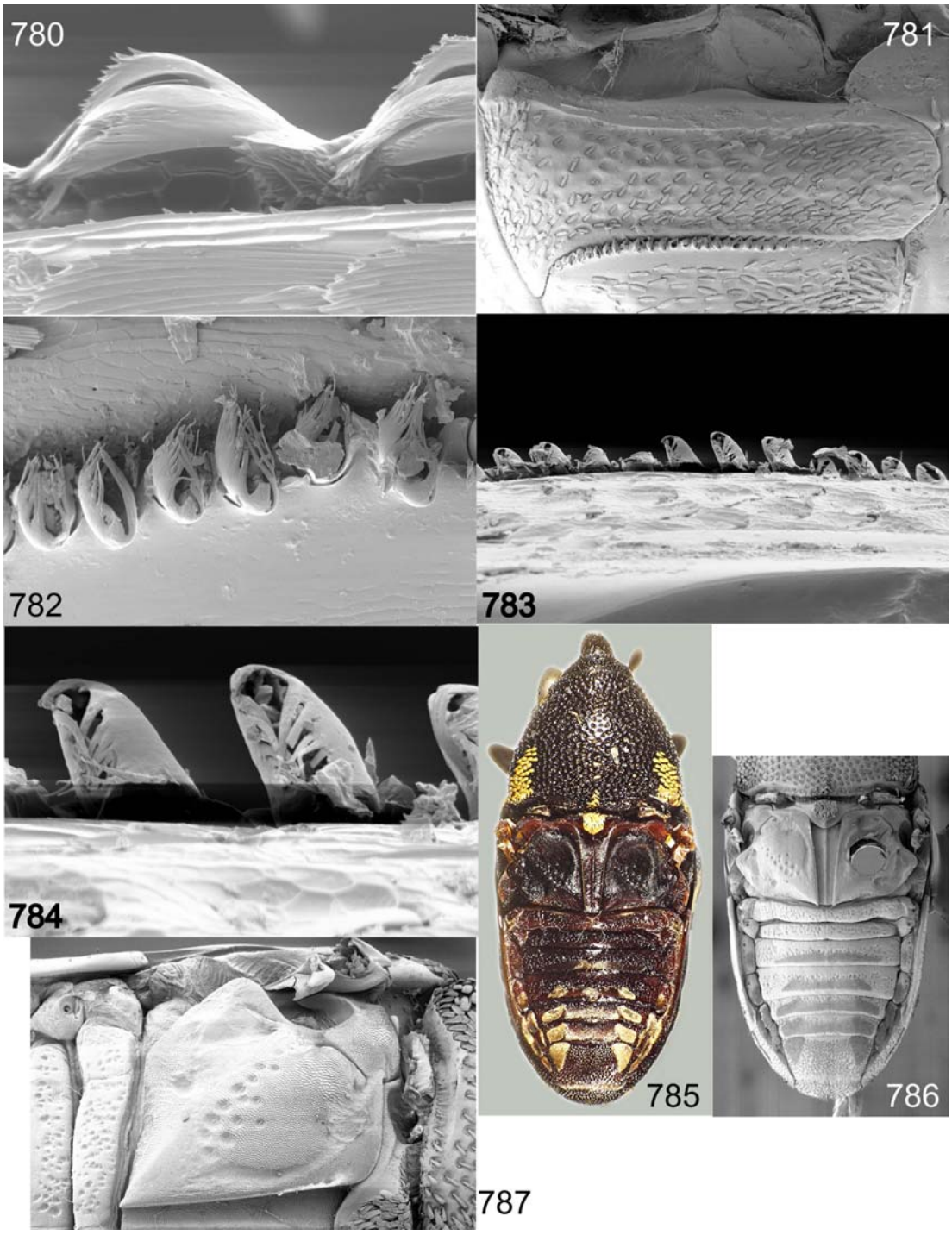
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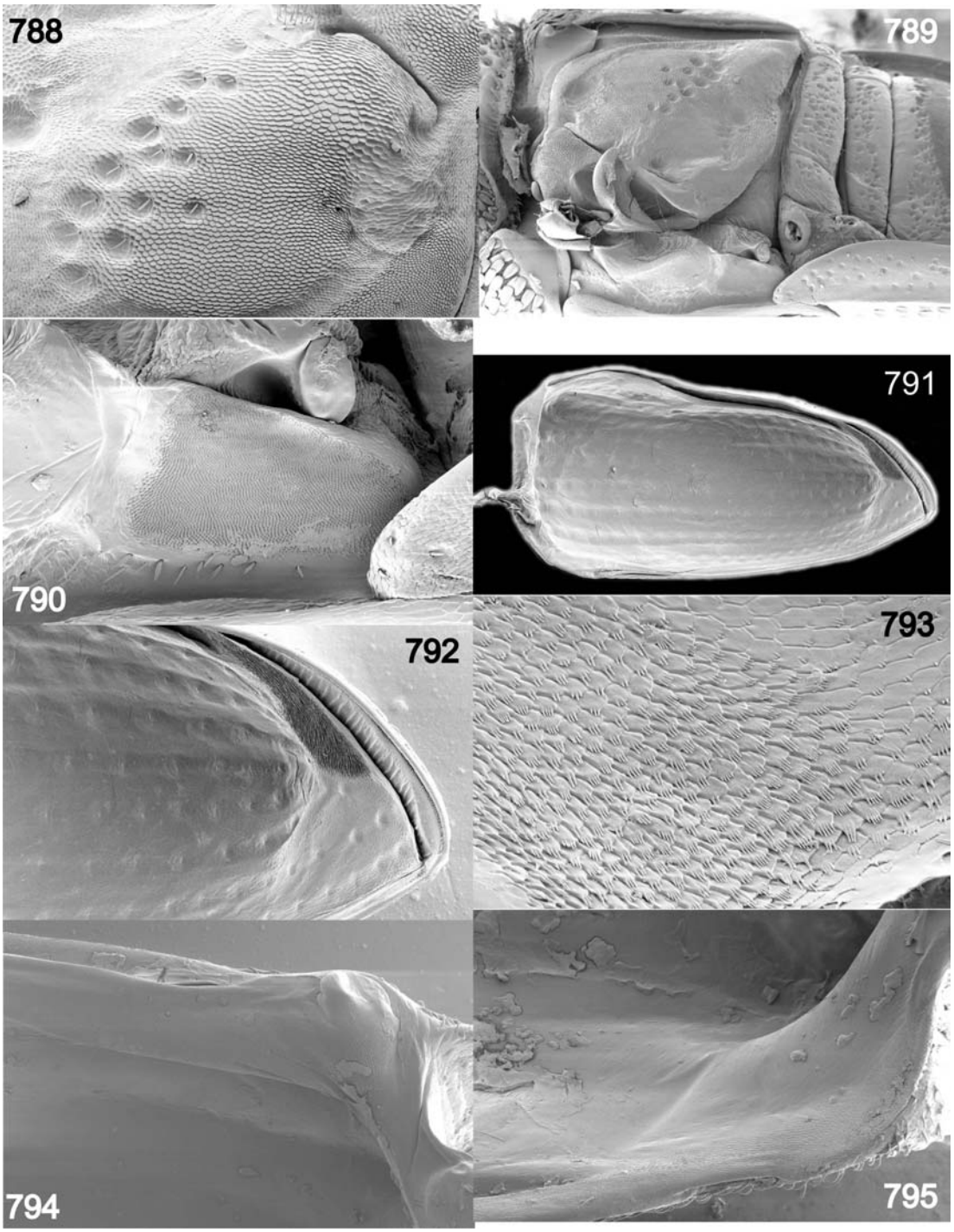
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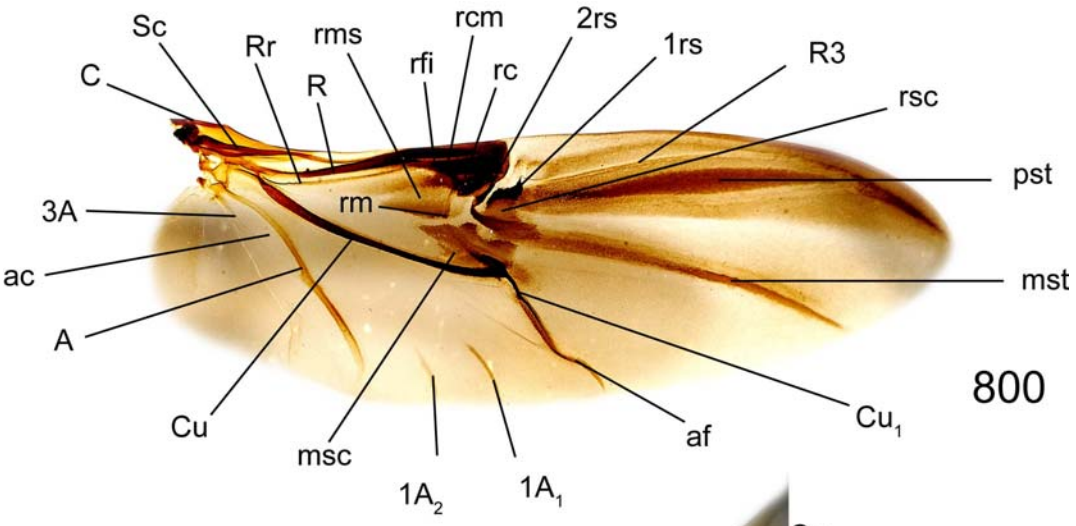
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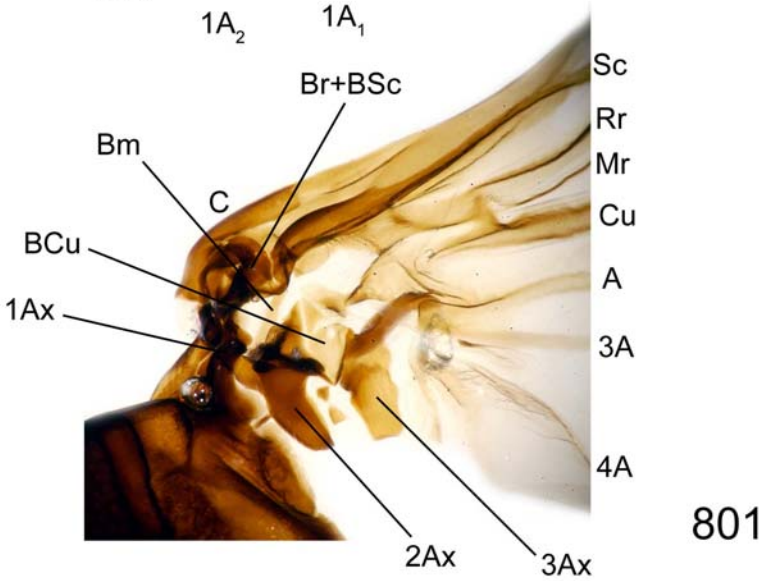
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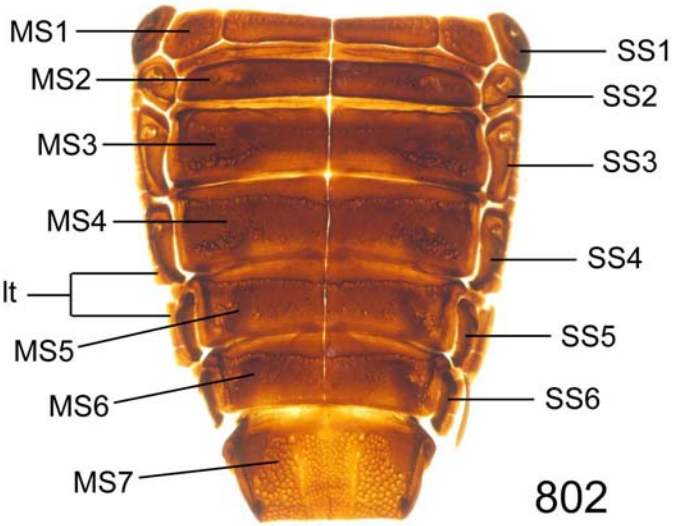
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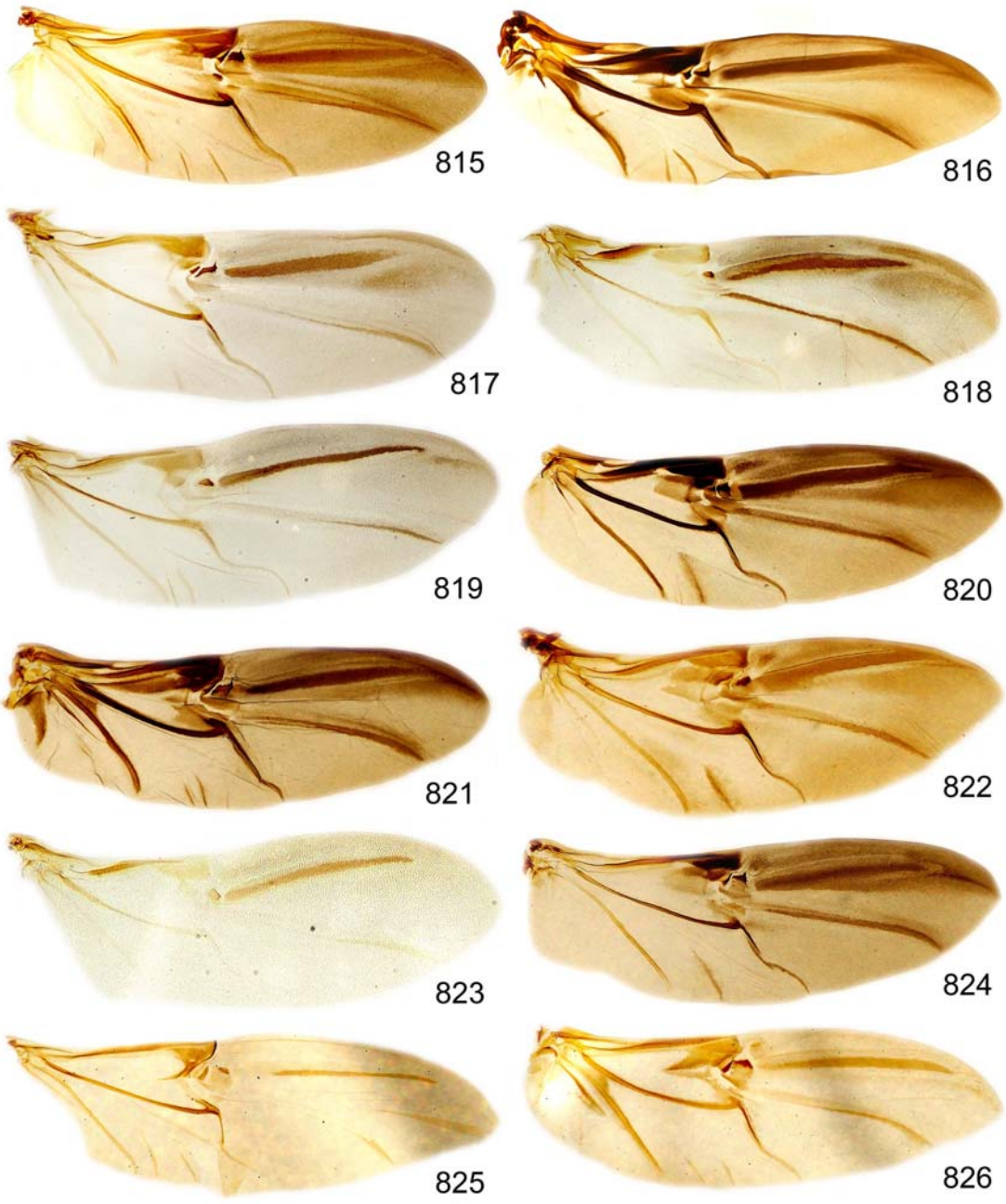
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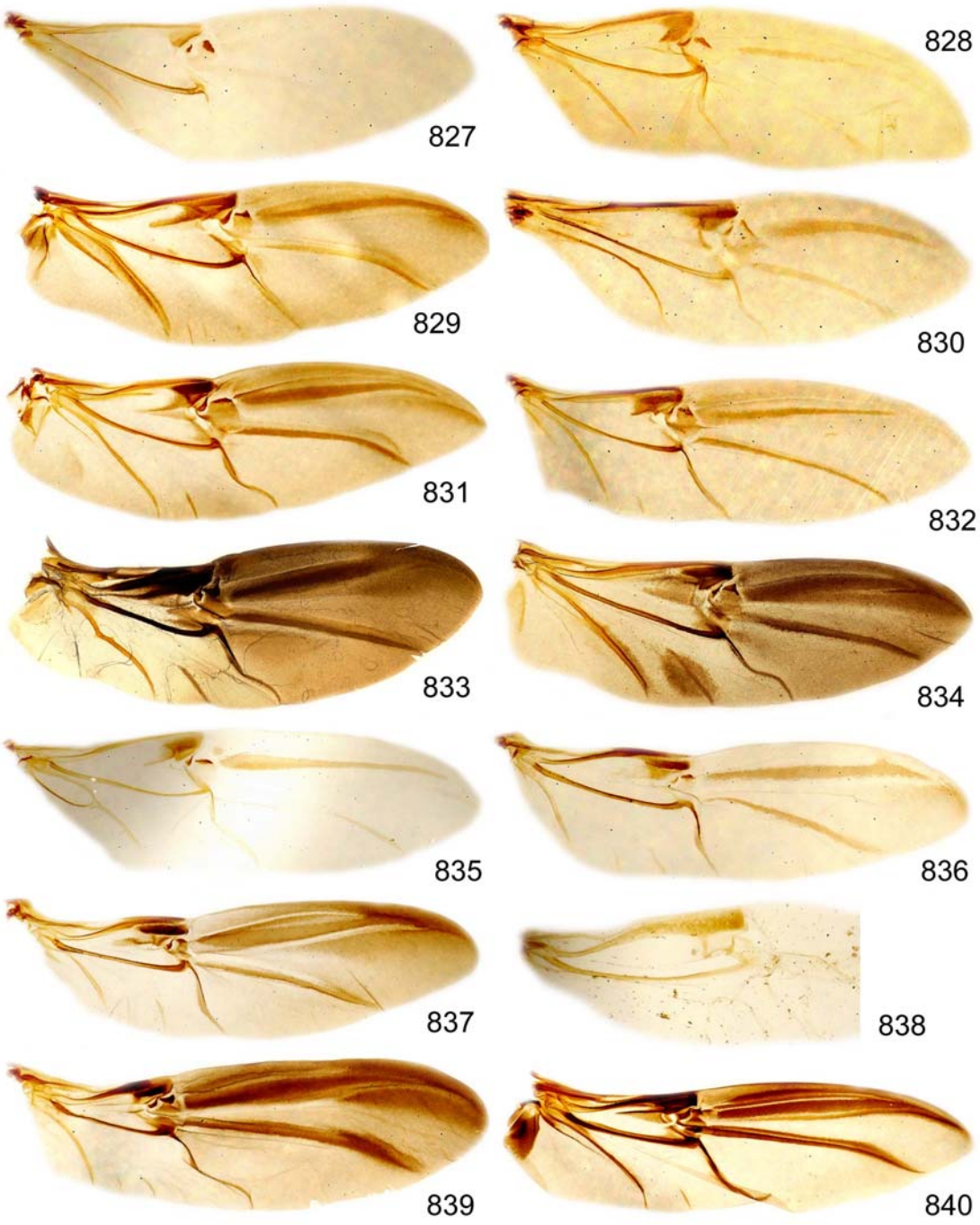
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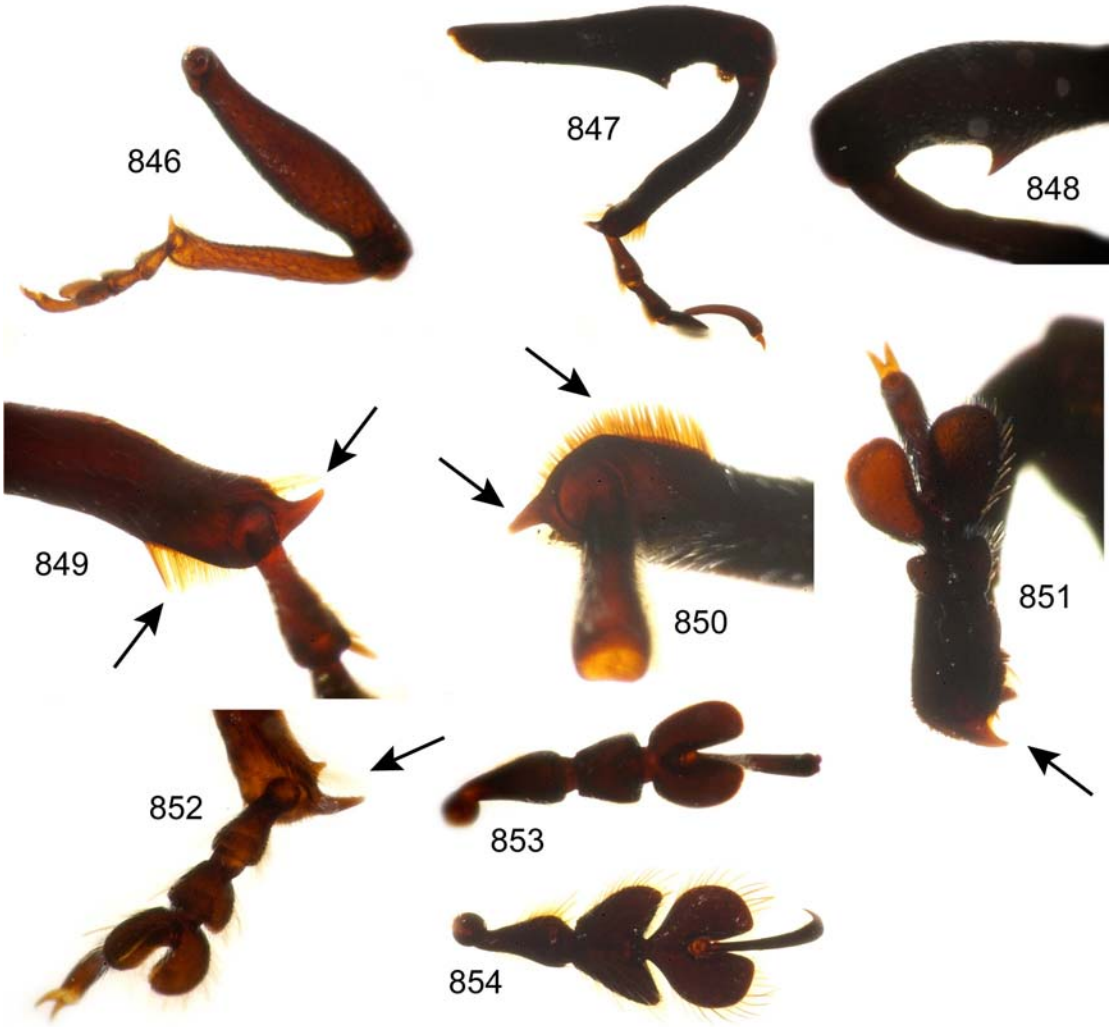
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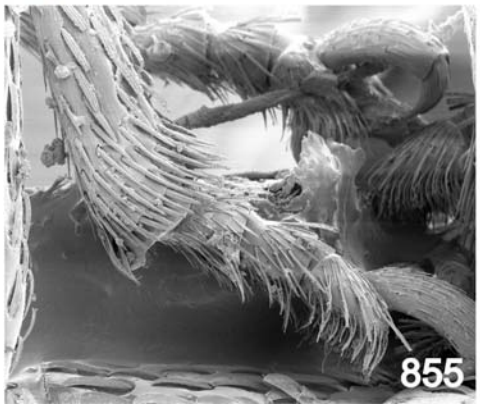
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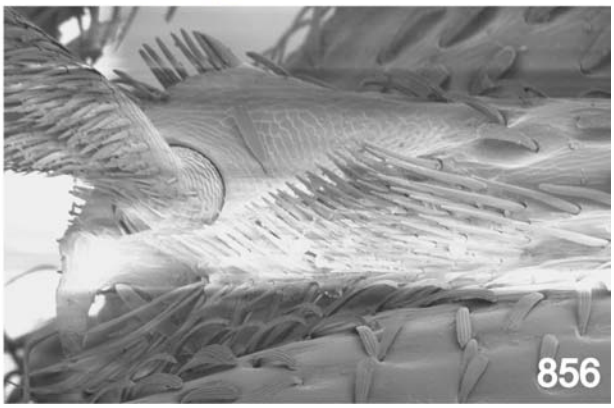
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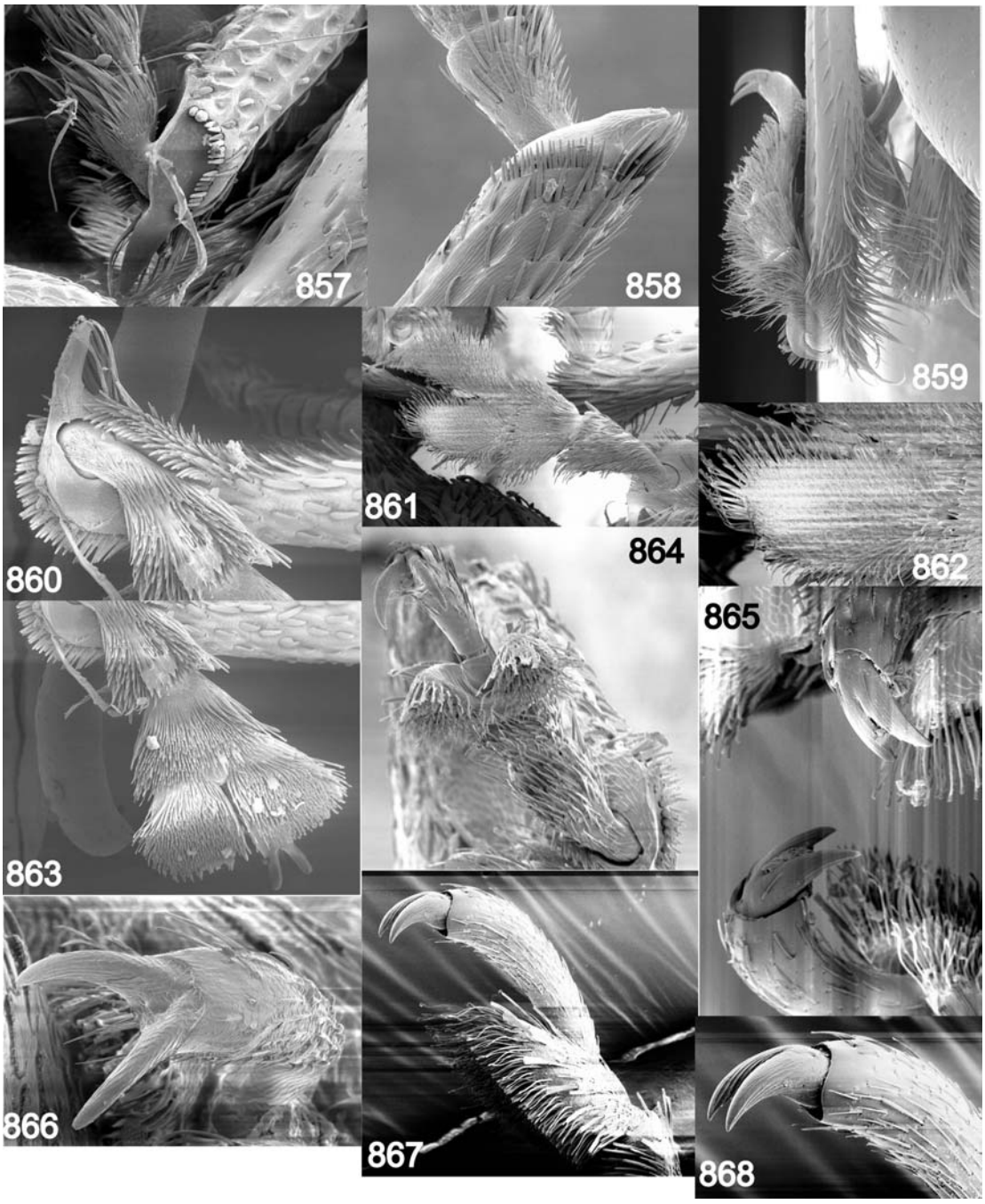
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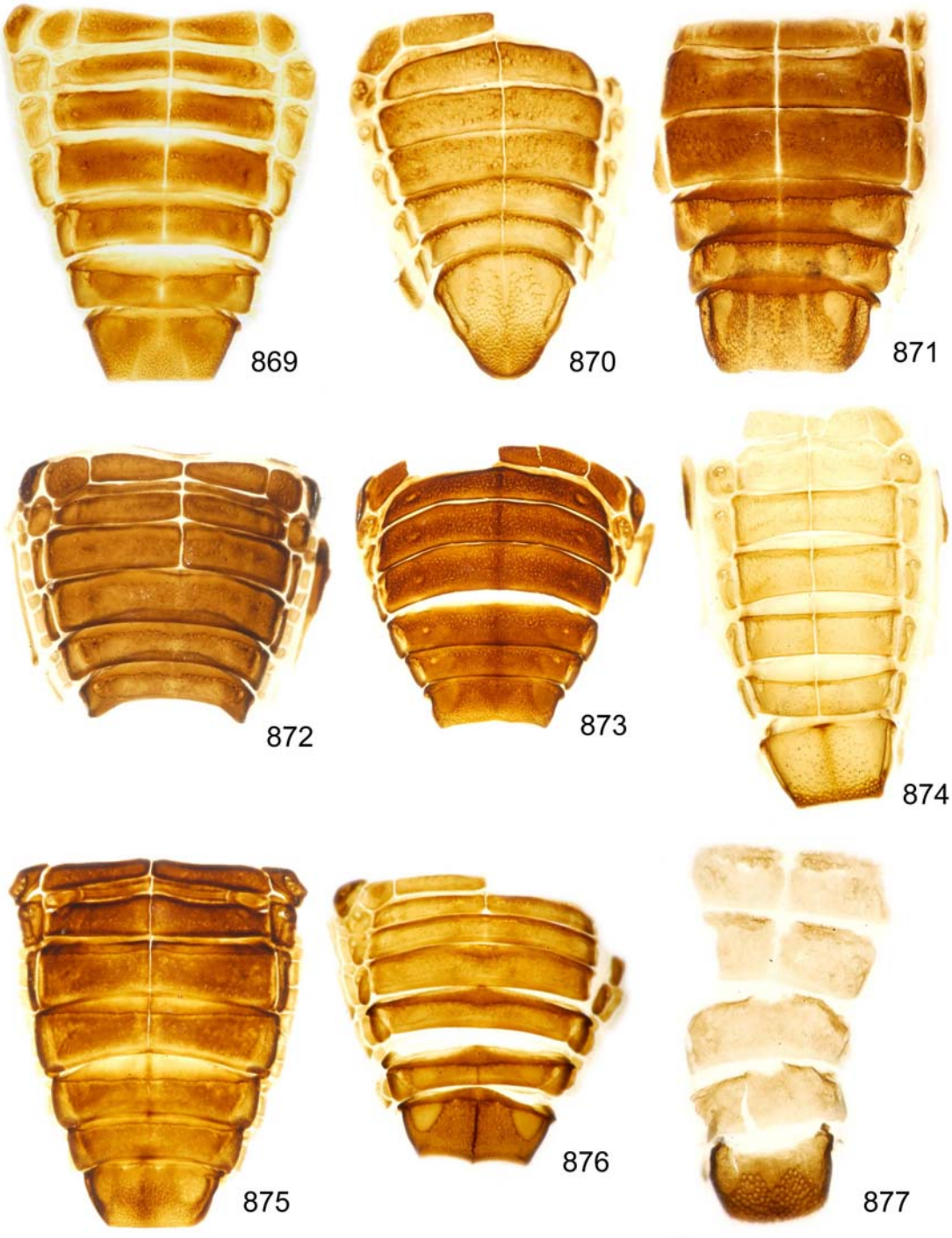
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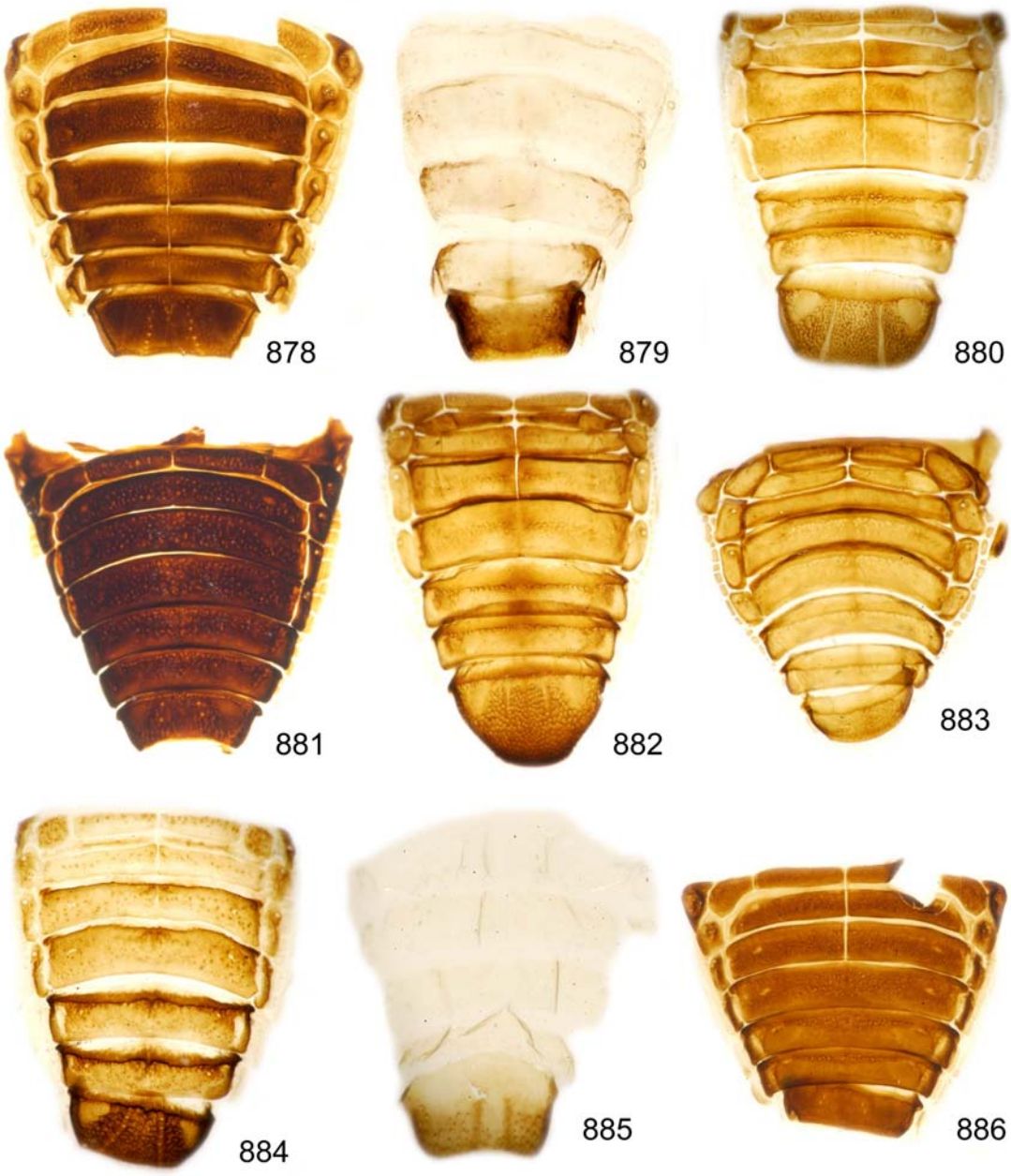
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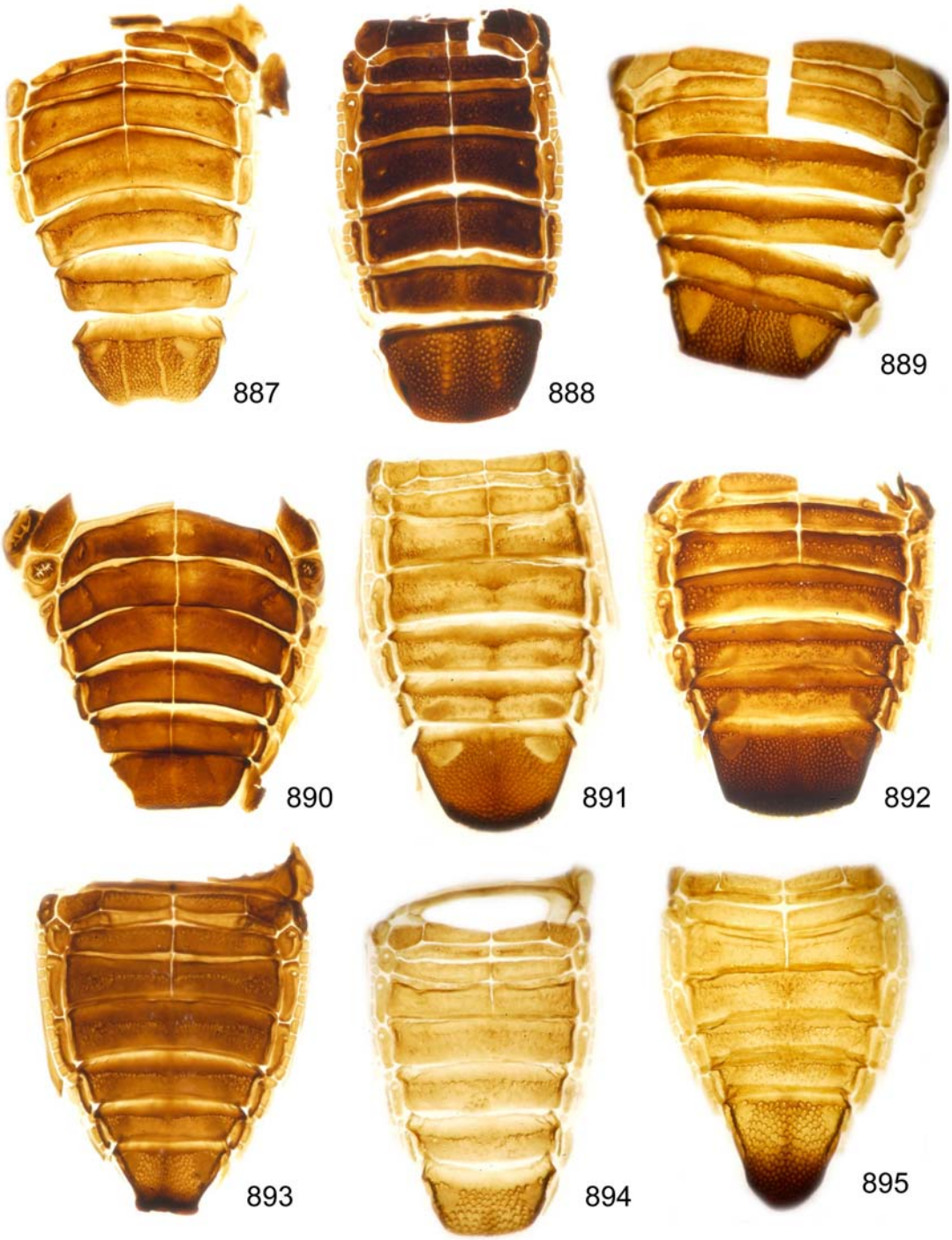
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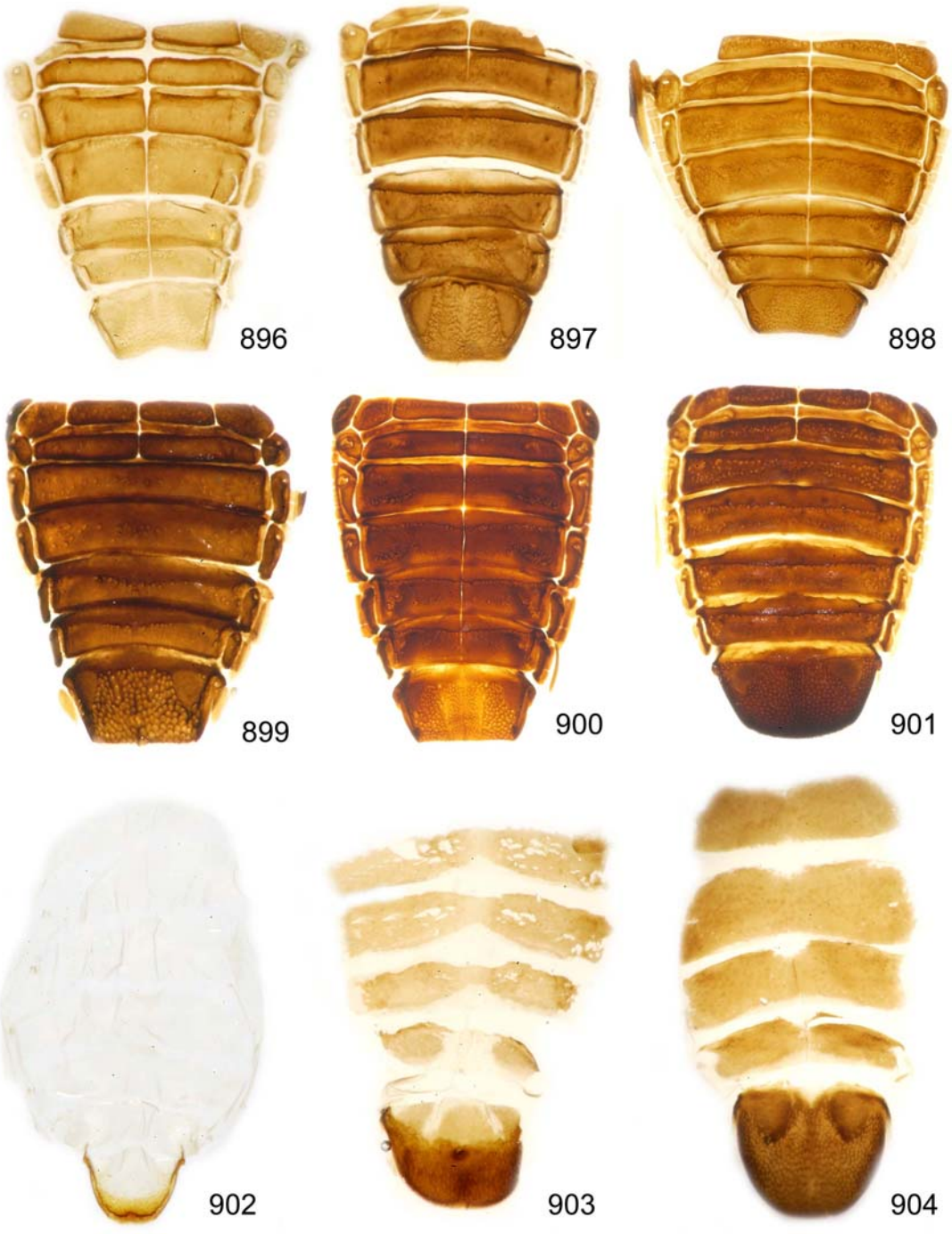
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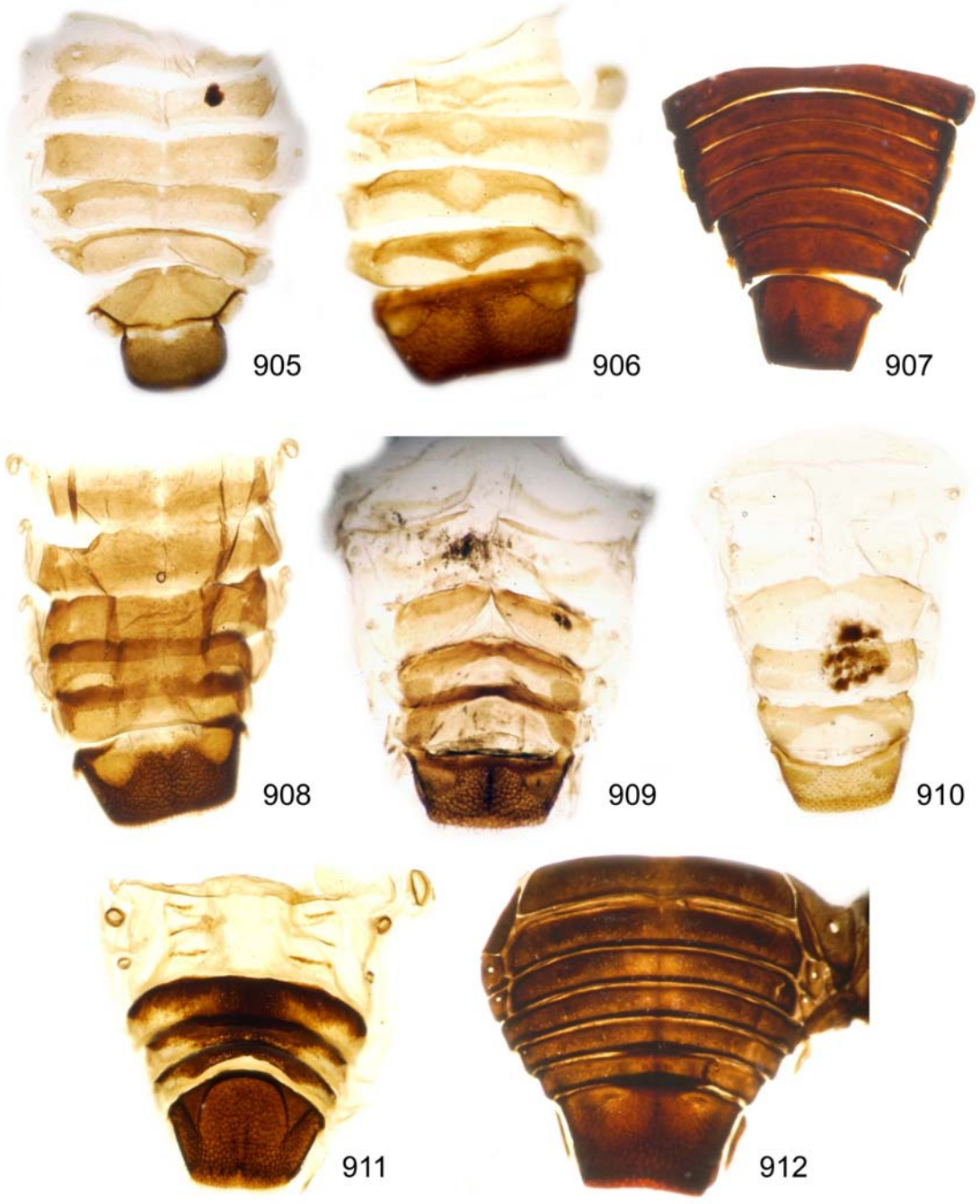
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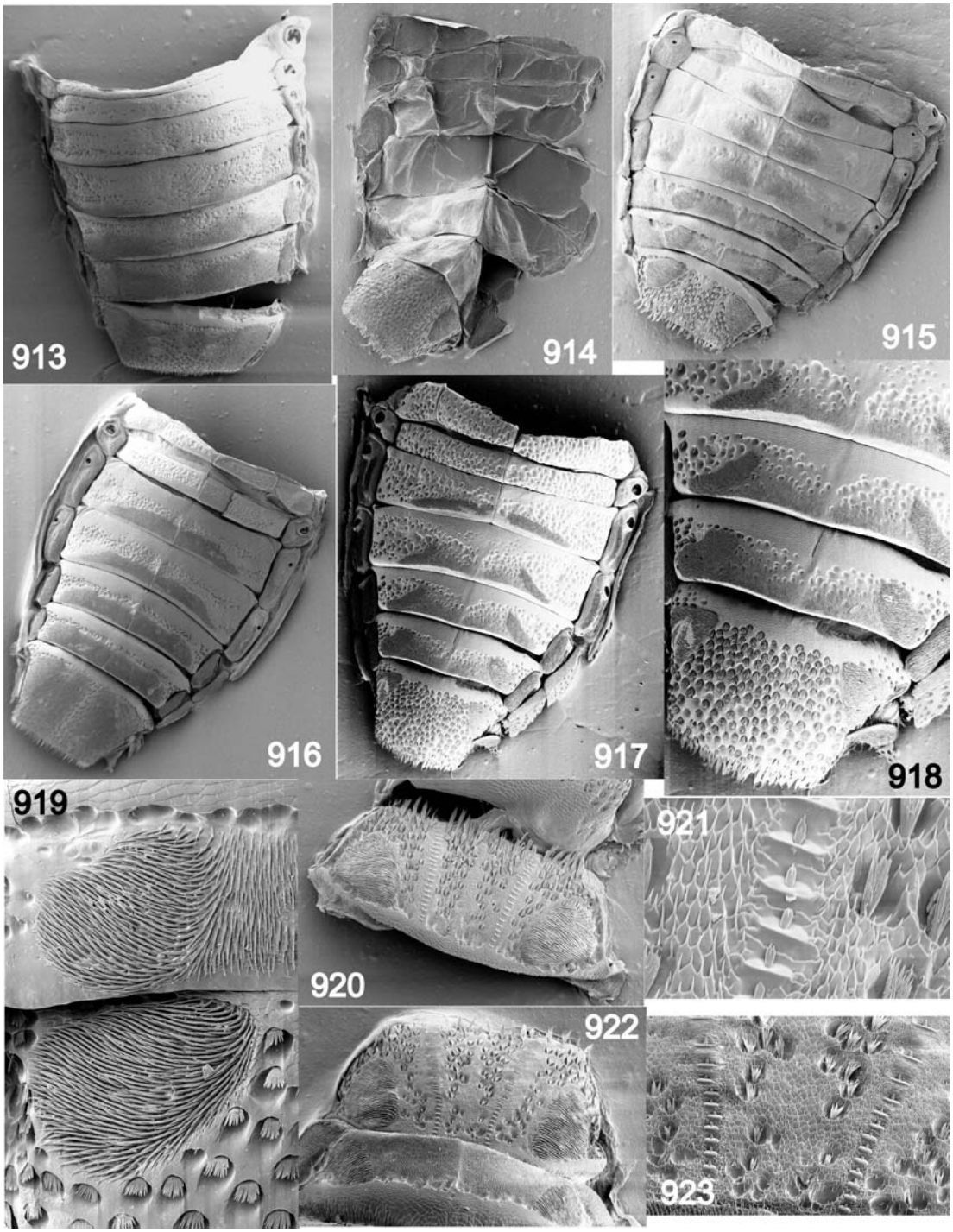
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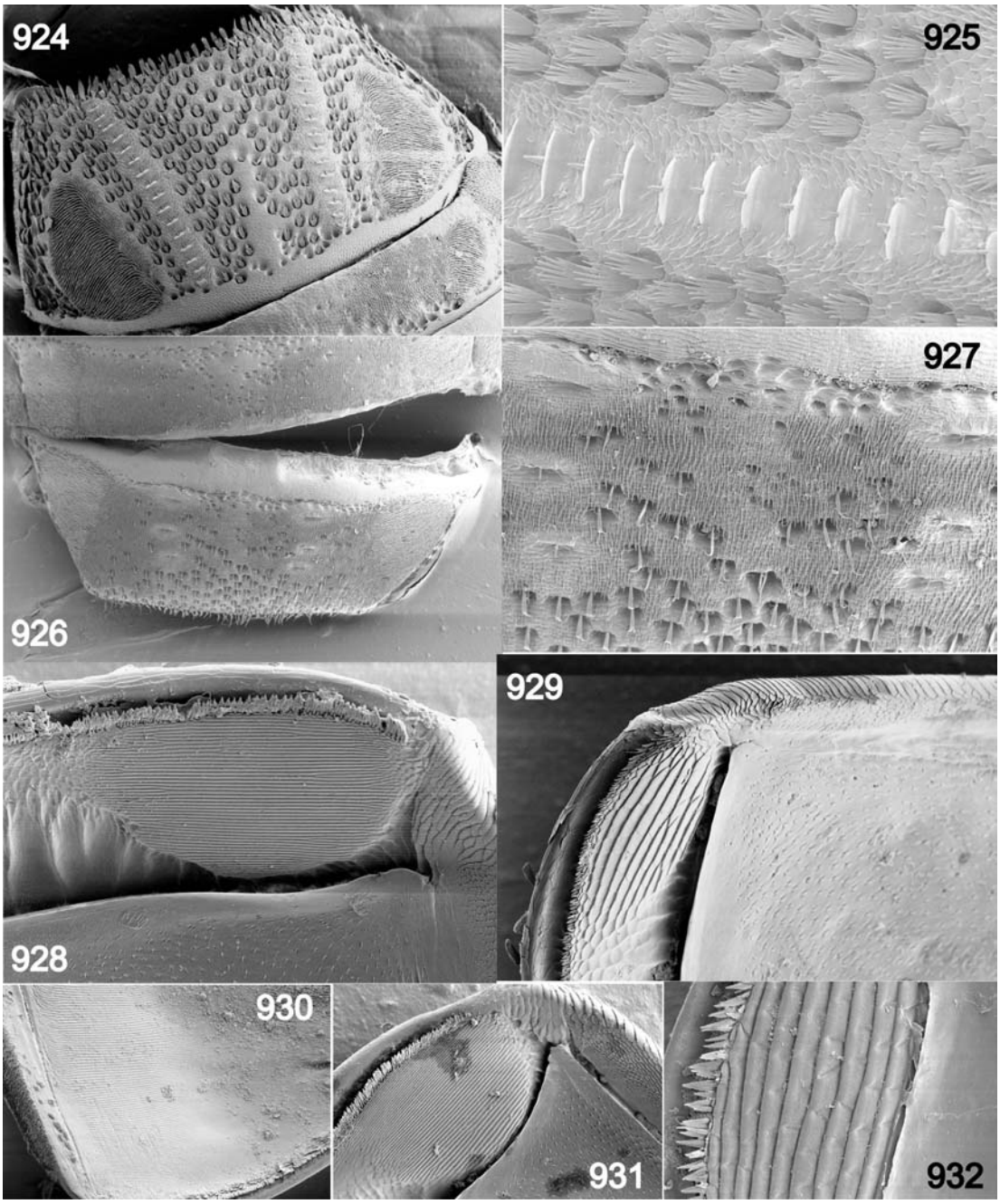
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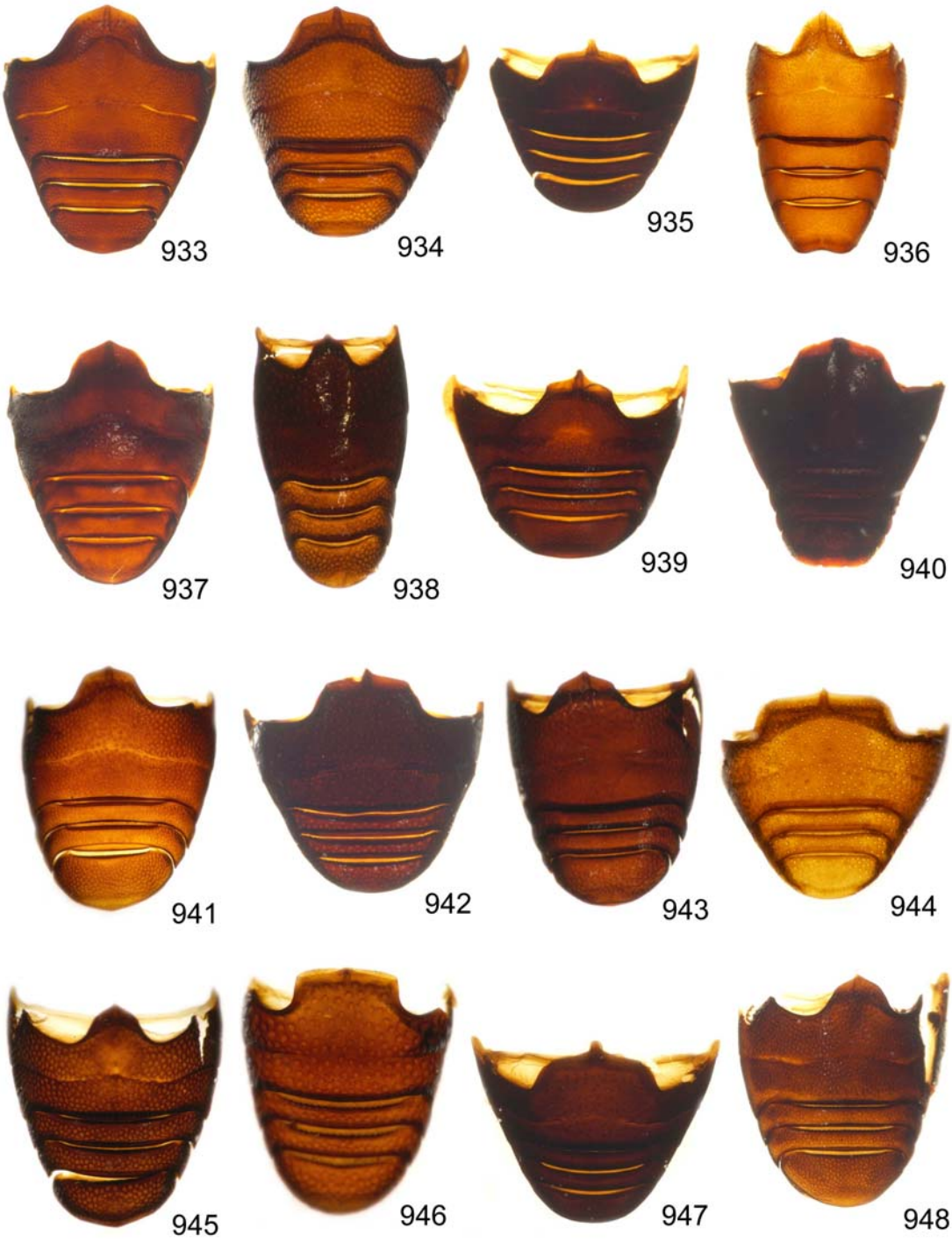
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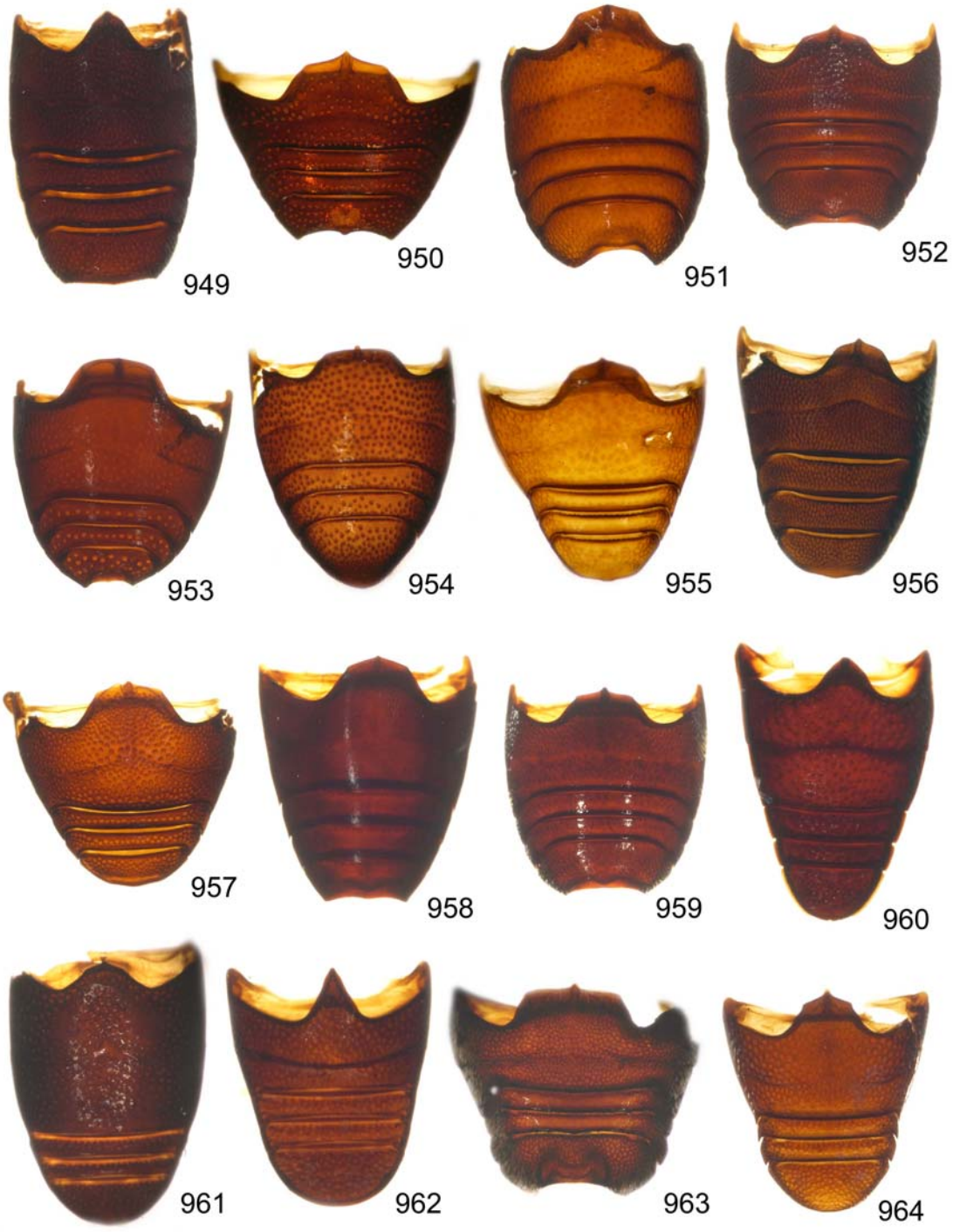
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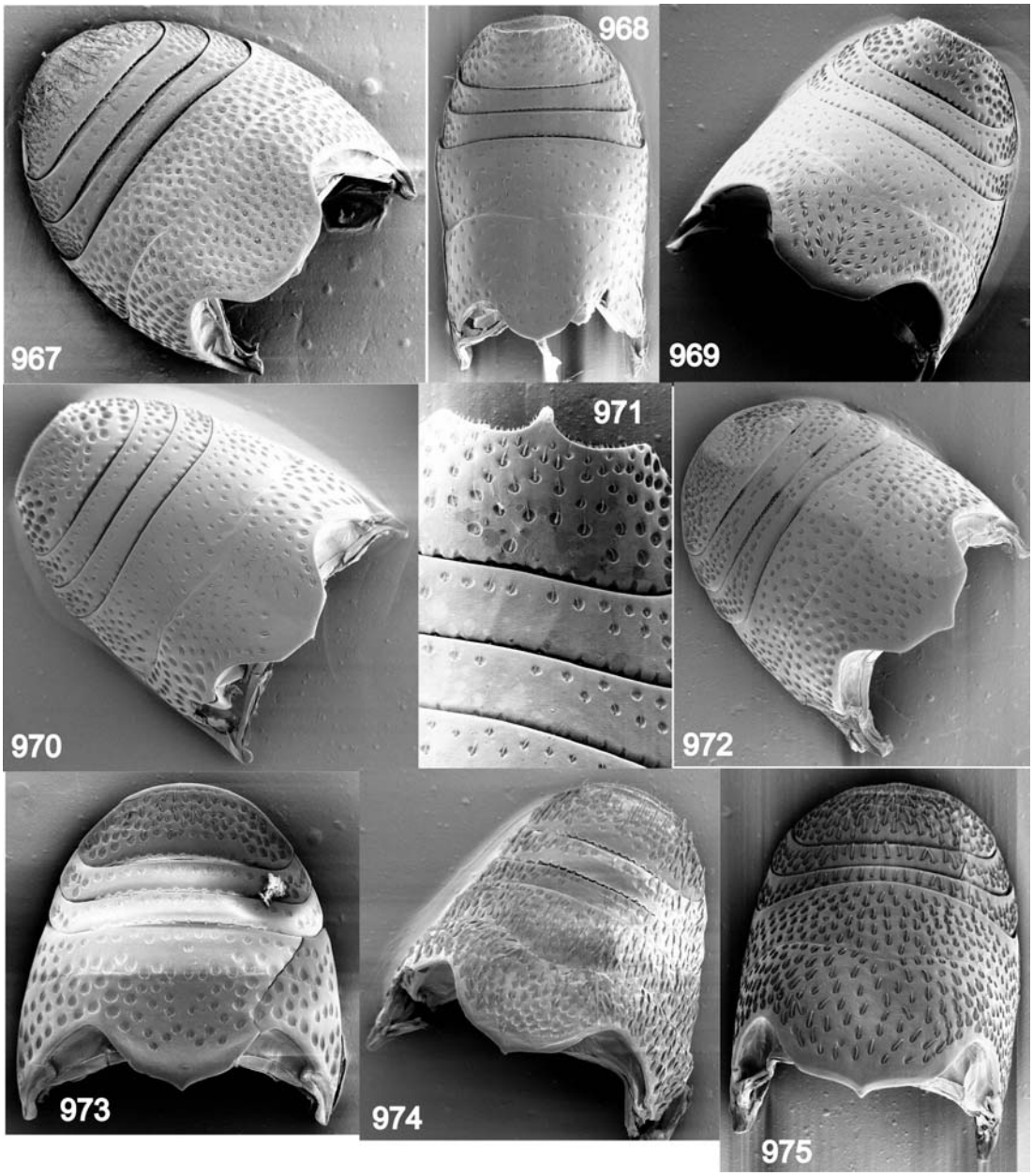
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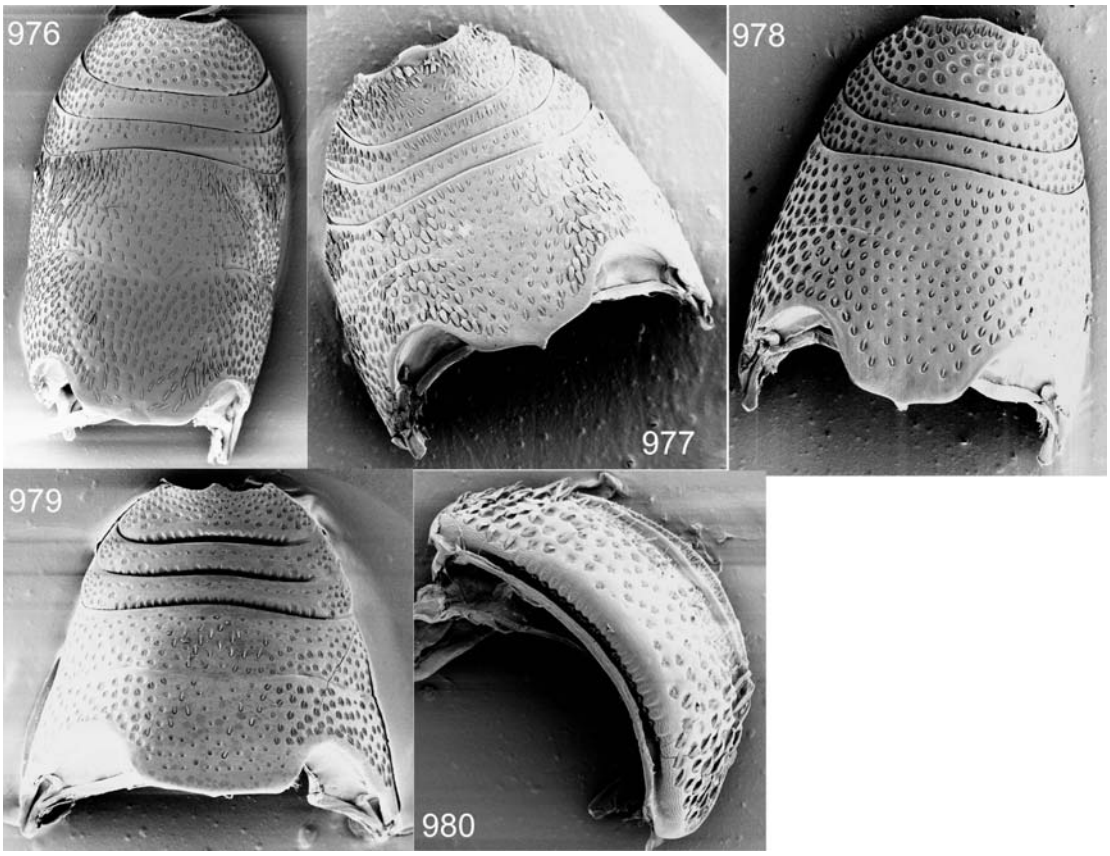
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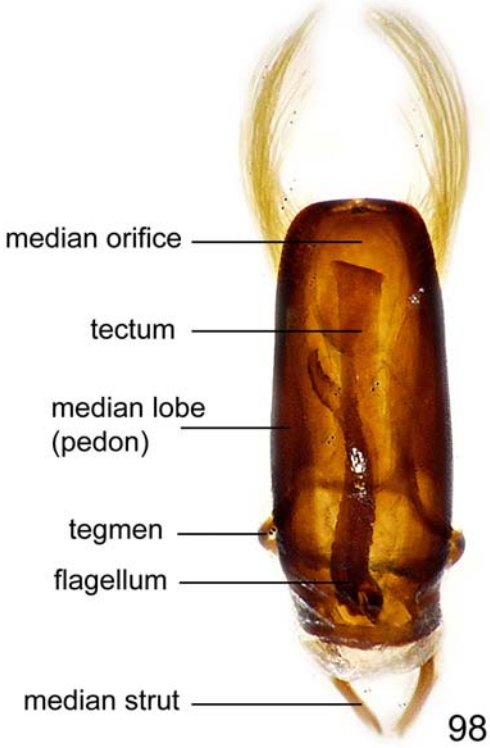

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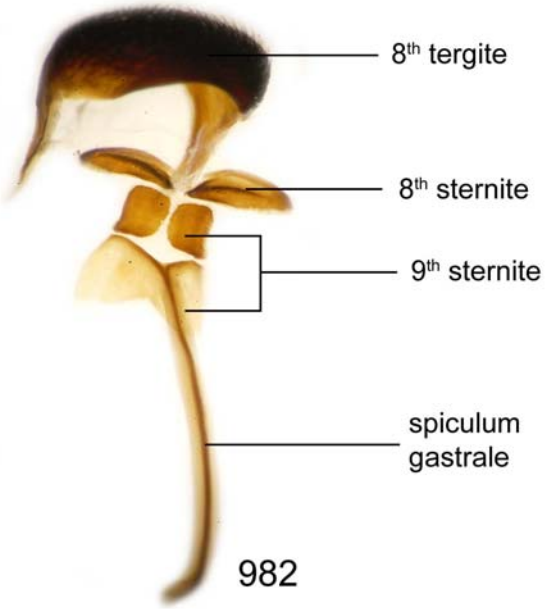

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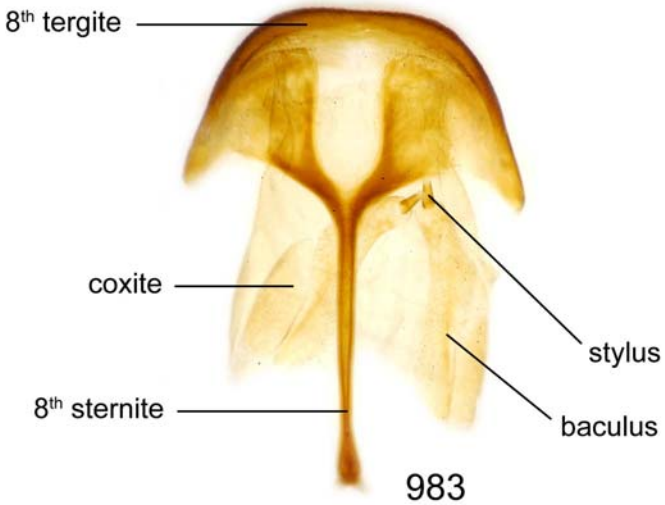

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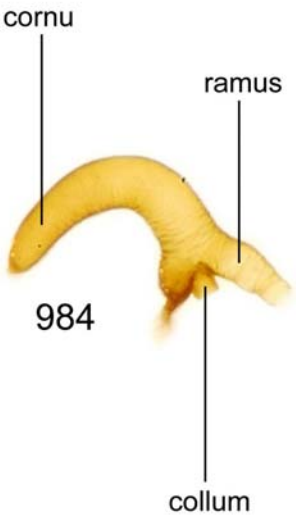

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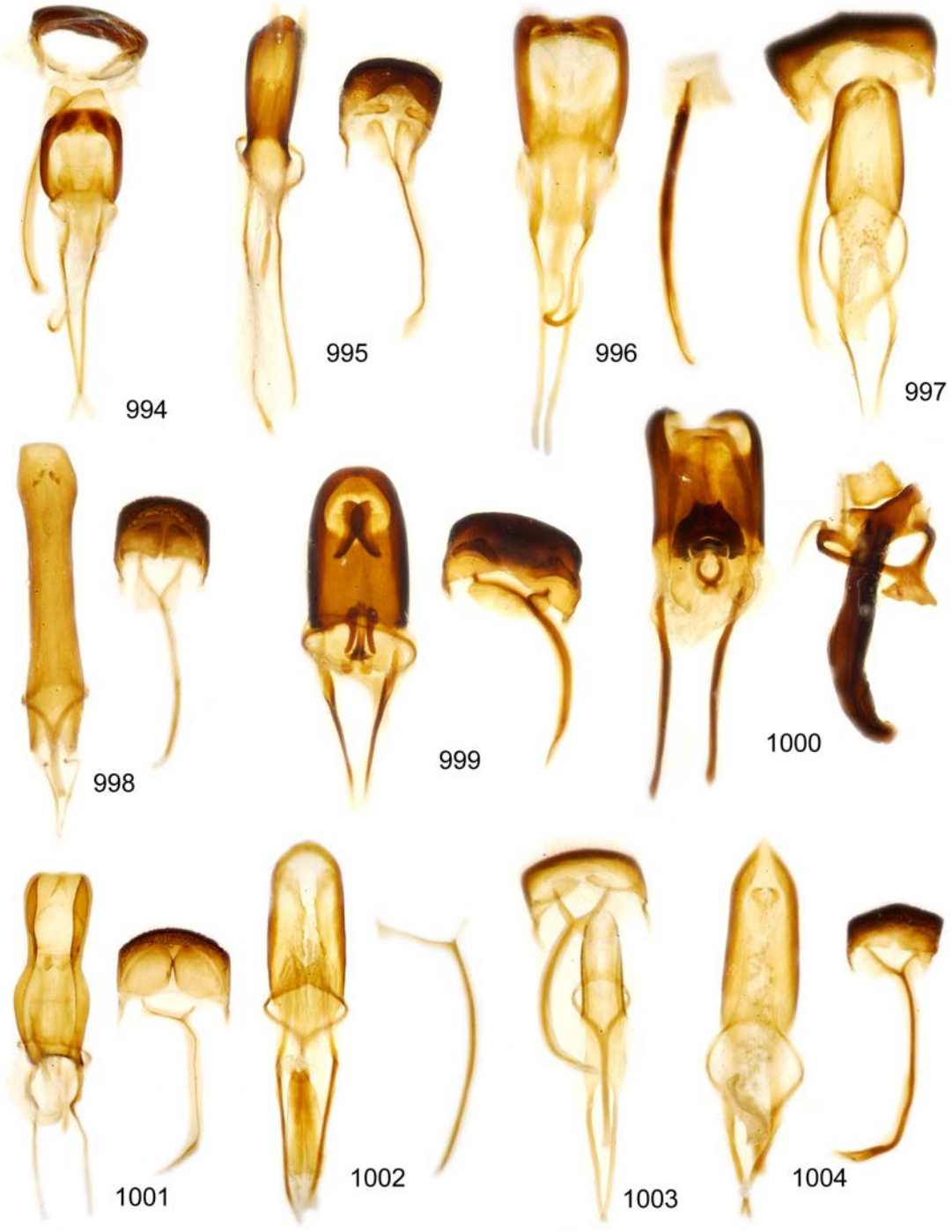
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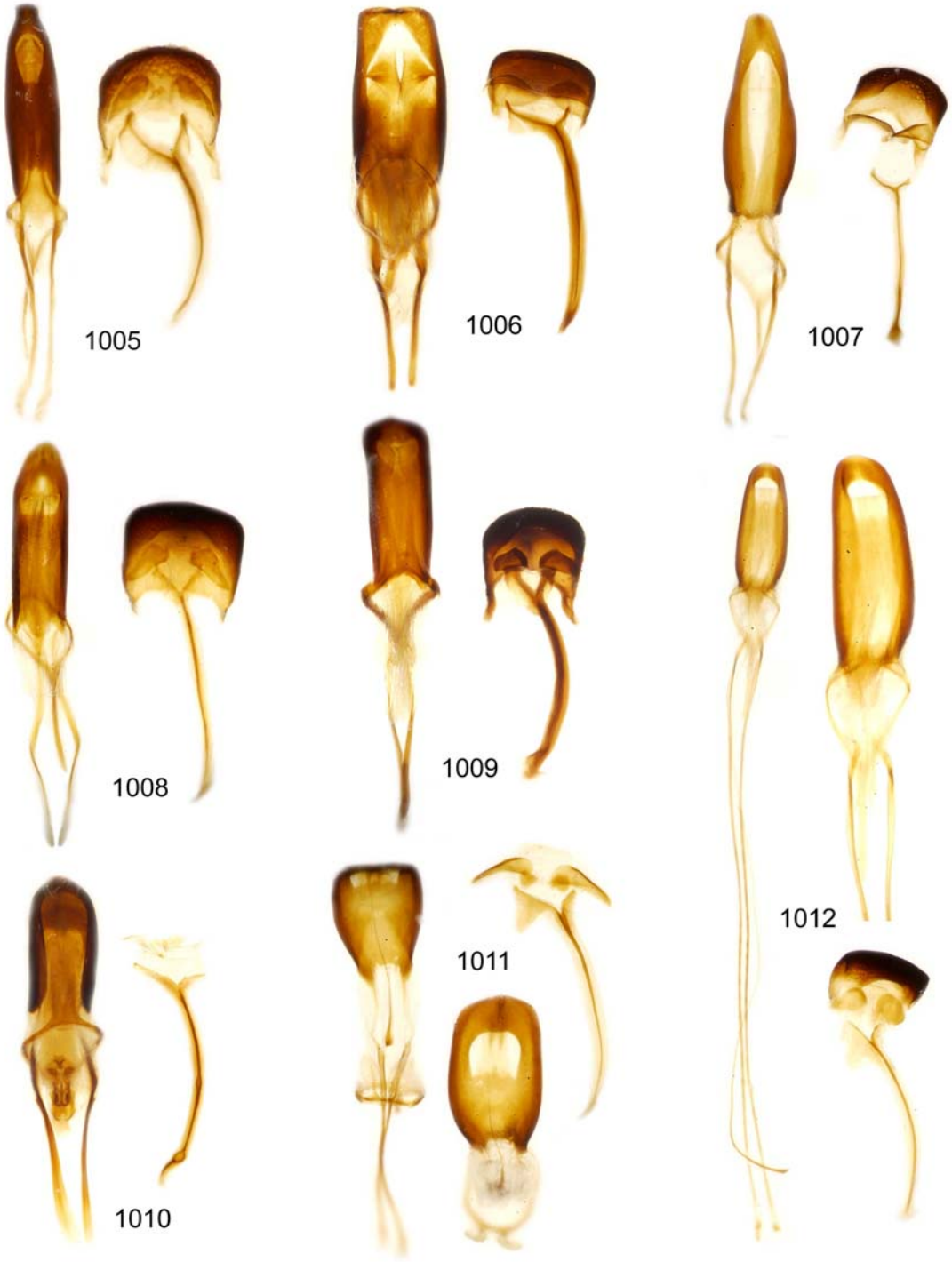
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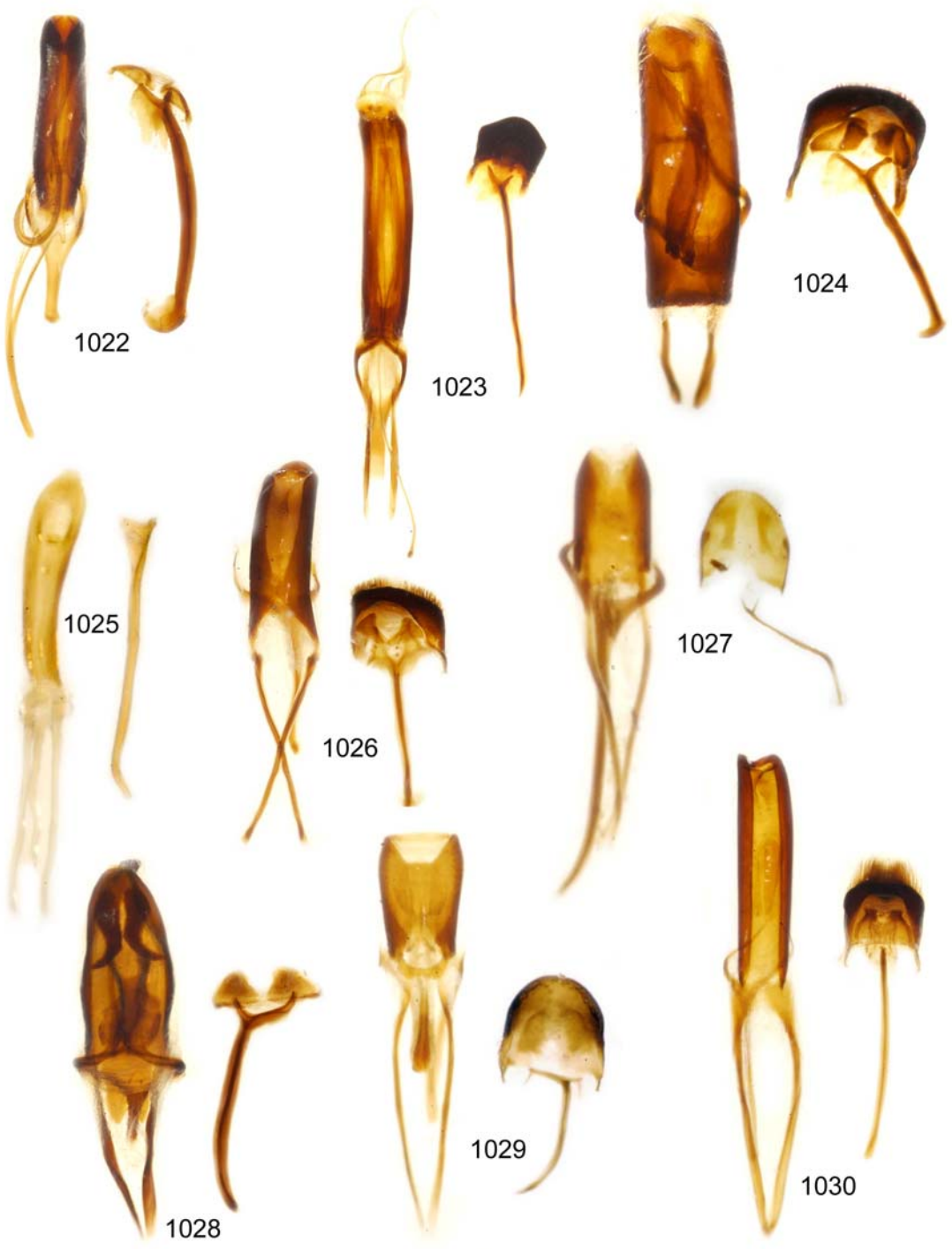
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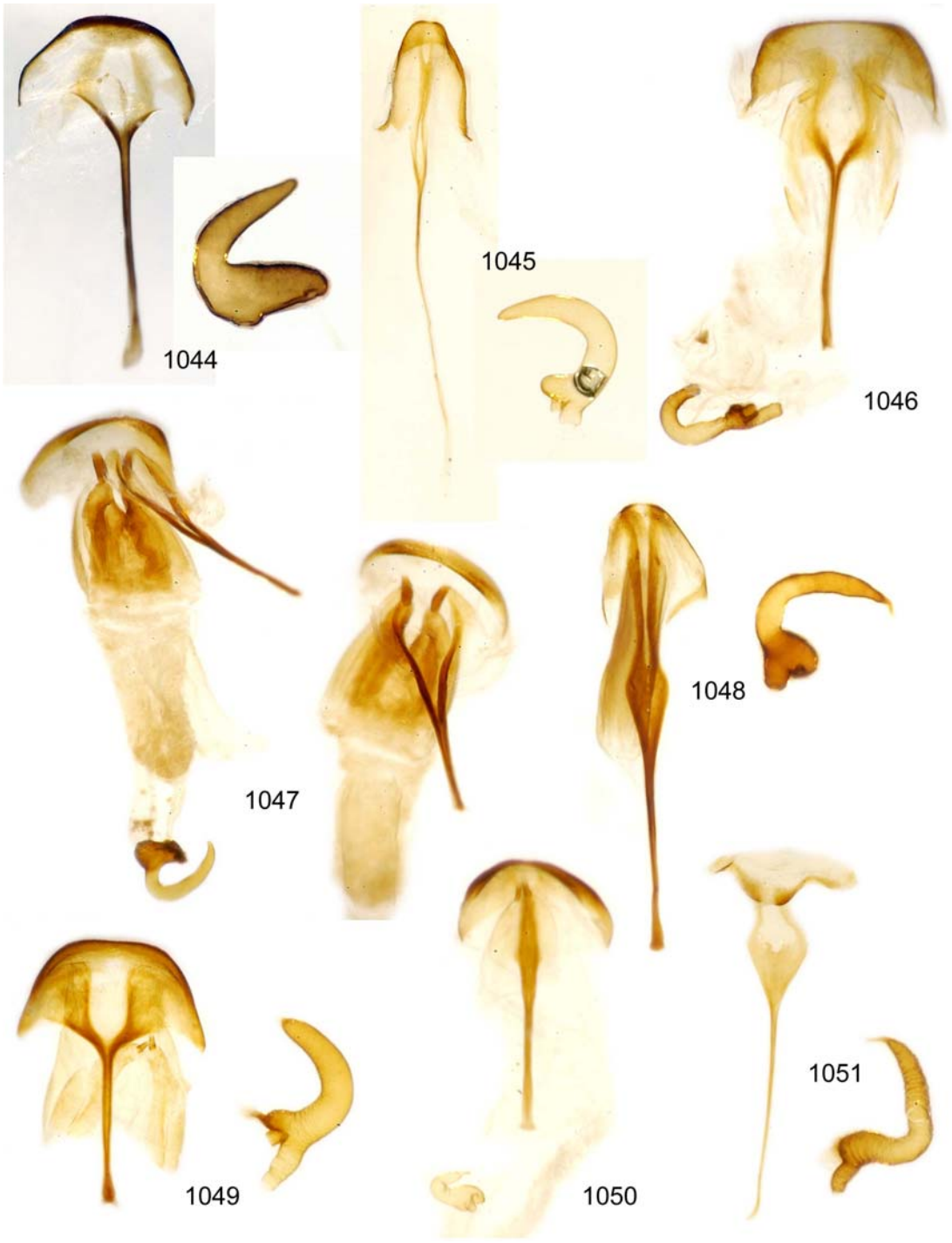
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Chapter II: Delimiting baridine evolution (Coleoptera: Curculionidae)

Abstract

Since the erection of the weevil subfamily Baridinae by Schoenherr in 1836, no phylogenetic hypothesis has been derived for this extraordinarily diverse group. This study provides the first phylogenetic results of Baridinae, including 301 taxa and 113 morphological characters. Despite fairly well-resolved results, indicating paraphyly of nearly all of the currently recognized intrasubfamily divisions, no change to the current classification is made. Even though groupings are proposed based on the final results, it is believed that more rigorous analyses need to be made prior to a re-evaluation of the current classification.

Introduction

Currently there are approximately 550 genera belonging to the subfamily Baridinae (Morimoto and Yoshihara 1996), placed into 9 tribes and 17 subtribes (Alonso-Zarazaga and Lyal 1999). Although cosmopolitan in distribution, the greatest diversity of baridine weevils lies in the New World, particularly the Neotropics (Prena 2001). Indeed the morphological diversity within Baridinae is vast, but the number of natural groups, particularly at the generic level, is believed to be highly over-split and remains to be assessed. The major researchers to develop

baridine classification include Lacordaire (1863, 1866), Champion (1907), Hustache (1938), Casey (1892, 1920, 1922), Zherikhin and Gratshev (1995), and to somewhat a lesser extent, Pascoe (1889), Voss (1958), and LeConte and Horn (1978).

The subfamily was first erected by Schoenherr in 1836. Until the present, Baridinae has changed in both name and rank several times. Casey (1922) divided Barinae into 14 tribes in his treatment of the Brazilian fauna, Ambatini, Pantotelini, Cyrionichini, Optatini, Diorymerini, Coleomerini, Coelonertini, Centrinini, Limnobarini, Sonnetiini, Madarini, Eurhinini, Barini, Madopterini. This classification was quite dubious, owing to artificial groupings that were based on few characters of little importance when examined alone, such as inter-coxal distance and body shape. Casey, himself, admits that the limits between many of the tribes are indistinguishable, most likely due to his coarse examination of taxa and utilization of few characters.

Hustache's 1938 treatment divided Barinae (now Baridinae) into 7 tribes (Table 1).

Table 1. Classification of Barinae according to Hustache (1938).

Tribe	Subtribe
Ambatini Lacordaire	
Peridinetini Lacordaire	
Pantotelini Lacordaire	**Pantotelina** Lacordaire
	Cyrionychina Casey
Optatini Champion	
Barini LeConte	**Diorymerina** Jekel

	Coleomerina Casey
	Coelonertina Casey
	Eurhinina Lacordaire
	Barina LeConte
Centrinini Lacordaire	**Centrinina** Lacordaire
	Madopterina Lacordaire
	Apostasimerina Schoenherr
Madarini Jekel	
	Lyteriida Hustache
	Leptoschoina Lacordaire
	Eutoxina Champion
	Madarina Jekel
	Barymerina Lacordaire

LeConte and Horn regarded Baridinae as a tribe within Curculionidae, Barini, and divided the tribe into 2 groups, Barides and Centrini, based on the North American fauna. Zherikhin and Egorov (1990) recognized Baridinae as containing 5 tribes, Baridini, Trigonocolini, Zygopini, Ceutorhynchini, and Orobitini. This division was based on the presence of a longitudinal crest on the scutellar groove of the metanotum, a transverse carina along the hind margin of the pronotum, a strongly curved submarginal fold along the latero-ventral margin of the elytron, and the fusion of the metepimeron and the metepisternum. In a slightly later publication, Zherikhin and Gratshev (1995) proposed a similar classification as did Zherikhin and Egorov, but recognized Baridinae as a family, Baridiidae, and divided it into 4 subfamilies, Baridinae, Ceutorhynchinae, Trigonocolinae, and Zygopinae. They also proposed Brachyceridae as the possible sister-group to Baridiidae. This classification was based

largely on the examination of hind-wing characters, as well as prior hypotheses put forward by Zherikhin and Egorov. Although many of the hind-wing synapomorphies, proposed by Zherikhin and Gratshev, for Barididae are fairly precise, such as the cu-a crossvein always absent and 4A strongly reduced, most of them are not accurate as a result of poor taxon sampling, such as the absence of r-m in Baridinae (which can actually be present in a few genera). Oberprieler *et al.* (2007) follow the classification proposed by Zherikhin and Gratshev (1995), while also noting that this classification also brings together groups that share other features, such as the ascending metepisternum. They also mention, however, that none of the characters used by Zherikhin and Gratshev, nor by any previous authors who have proposed classifications of baridine weevils, have been tested in a phylogenetic analysis.

The current, most widely-accepted classification of Baridinae is based on Alonso-Zarazaga and Lyal (1999). It largely follows the classification system of Hustache (1938), and divides a total of 546 genera into 9 tribes (including 17 *incertae sedis* genera; Table 2).

Table 2. Current classification of Baridinae (*sensu* Alonso-Zarazaga and Lyal 1999).

Tribe	Subtribe
Ambatini Lacordaire	
Anopsilini Bondar	
Baridini Schoenherr	**Baridina** Schoenherr
	Coelonertina Casey
	Coleomerina Casey
	Diorymerina Jekel
	Eurhinina Lacordaire

Madarini Jekel	**Madarina** Jekel
	Barymerina Lacordaire
	Eutoxina Champion
	Leptoschoinina Lacordaire
	Tonesiina Alonso-Zarazaga & Lyal
Madopterini Lacordaire	**Apostasimerina** Lacordaire
	Madopterina Lacordaire
	Thaliabaridina Bondar
	Torcina Bondar
	Zygobaridina Pierce
Nertinini Voss	
Optatini Champion	
Pantotelini Lacordaire	**Cyrionychina** Casey
	Pantotelina Lacordaire
Peridinetini Lacordaire.	

Despite the large size of the subfamily, the majority of genera are placed within Madopterini, Baridini, and Madarini, in succession.

Baridines are quite easily differentiated from most other weevil groups by their characteristic round shape and ascended mesepimeron; however, these traditional diagnostic characters certainly are not apomorphic to baridines only, and beyond the level of subfamily, baridine identification is difficult at best. Also, because there have been no phylogenetic studies completed to date for baridines, different classifications are being used simultaneously (Alonso-Zarazaga and Lyal 1999; Zherikhin and Egorov 1990; Zherikhin and Gratshev 1995; Oberprieler *et al.* 2007). Because there have been few comprehensive studies assessing character systems for baridine weevils, it is uncertain which classification depicts the evolution

of this group best. Although the baridines undoubtedly form a cohesive group, the delimitations of this group also remain uncertain. Due to the lack of phylogenetic structure in the subfamily, it seems of dire importance to begin the task of searching for diagnostic characters, testing these characters in a phylogenetic analysis, and ultimately working towards defining a framework for the taxa that compose a monophyletic Baridinae.

Materials and methods

Taxon sampling (Appendix I)

Following Alonso-Zarazaga and Lyal (1999), species were sampled from each of the 9 tribes and 17 subtribes in Baridinae, with a total of 283 baridine species, representing 231 genera, included in the analysis (Table 1). A total of 29 species were sampled for the outgroup, consisting of 12 subfamilies outside of Baridinae. Due to ambiguity in hypothesized sister-groups to Baridinae, a range of outgroups were included in attempt to produce a stronger inference (Nixon and Carpenter 1993). The final analysis included a total of 301 taxa (Appendix I). Outgroup selection was based on phylogenies produced by Marvaldi *et al.* (2002), and previous baridine classifications by Zherikhin and Egorov (1990), and Zherikhin and Gratshev (1995).

Taxa were borrowed from the following institutions:

USNM – National Museum of Natural History (United States National Museum), Smithsonian Institution, Washington, D.C., USA.

SEMC – Snow Entomological Museum, University of Kansas, Lawrence, Kansas, USA.

CMNC – Canadian Museum of Nature, Ottawa, Canada.

IZCAS – Institute of Zoology, Chinese Academy of Sciences, Beijing, China.

CAS – California Academy of Sciences, San Francisco, California, USA.

FMNH – Field Museum of Natural History, Chicago, Illinois, USA.

Specimen dissection and preparation

Body and genitalia dissection:

All dissections were performed using an Olympus SZ60 microscope. For each taxon in which multiple specimens were available, a full-body dissection was done for the male and abdominal dissection for the female (including genitalia). For taxa in which only holotype or paratypes were available (Table 2), no dissections were made and only external characters were coded. In some taxa, full-body dissections were not permited by the borrowing institution and thus only abdominal dissections were done for those males.

For body dissections, specimens were first relaxed by soaking them in warm water for ~10-15 minutes, the duration depending on the size of the specimen. The head, pro-thorax, meso- meta-thorax complex, and abdomen were then separated. Before digesting any internal tissues, the elytra and hind wings were removed and stored in glycerin, as digesting was not required for these parts. The remaining dissected parts were digested in a weak (~10%) KOH solution for 10-15 minutes,

again depending on the size of the specimen. Following digestion, all remaining internal tissues were removed and the sclerotized parts cleaned. The meso- and meta-nota were separated from the mesepimera, metepisterna, and metepimera, and subsequently separated from each other. The terga were separated from the sterna along one side, and the genitalia removed together with the 8th terga. After dissections were completed, all parts were stored in glycerin.

Mouthpart dissection:

Following dissection of the body, the head was digested further in 10% KOH for ~15-30 minutes, depending on specimen size. Under the microscope, the head was placed with the ventral side facing upwards. One pair of fine-tipped forceps was used to stabilize the rostrum while another pair was used to gently separate the postmentum of the labium from the submentum of the rostrum. The maxilla were subsequently removed in a similar fashion, separating them from the submentum at the cardo-submentum junction. The mandibles were then removed, separating them from the postcoila.

Hind wing and mouthpart preparation:

Following dissection of the hind wing from the thorax and mouthparts from the rostrum, these parts were then mounted on glass microscope slides for further examination. One hind wing from each body dissection was mounted on a slide in Euparal mounting medium. The labium, maxilla, and mandibles from the same

specimen were mounted on the same slide as the hind wing, but in Canadian balsam. The slide was then placed on a slide warmer to dry the mounting mediums.

Scanning Electron Microscopy:

All SEM images were captured using a LEO 1550 FESEM. Specimens were mounted on an SEM stub using Leit-C-Plast adhesive and an isopropanol-based colloidal graphite. Whole specimens were placed on insect pins or glued to paper points, securing the pin or point on an SEM stub using Leit-C-Plast. Dissected parts were mounted on a stub by securing them with a thin layer of colloidal graphite. After the desired parts were mounted, coating was performed using gold.

Character discussion

General appearance:

0. Adult body shape, dorsal view:

elongate, cylindrical - length > 2x width (0); round, spherical - length 2x width (or less) (1)

The body of the adult ranges from a general round, subcircular shape, as viewed dorsally (Fig. 2), to more elongate (Fig. 1).

1. adult body shape, lateral view:

round (0); dorso-ventrally compressed (1)

In the lateral view, adult body shape can be wide or round (Figs. 3, 4) or dorso-ventrally compressed (Fig. 5). This character is independent of body shape in the dorsal view.

2. body, overall shape:

spherical, round (0); not spherical (1)

In the lateral view, adult body shape may appear globose (Fig. 9). This shape is an extreme case of the round state in char. 1, where the dorsal surface, including the pronotum, become highly convex and angled.

3. pronotum-body size ratio:

pronotum narrower than abdomen (shoulders of elytra wide) (0); pronotum flush with abdomen, smooth, round (1); pronotum wider than abdomen (2)

In the dorsal view, the relationship between pronotum size and abdomen (elytra) size is observed in 3 conditions: the pronotum may be narrower than the elytra (Fig. 6), it may be wider than the elytra (Fig. 8), or it may be flush with the elytra, in which the lateral margins of the pronotum and elytra are smooth (Fig. 7).

4. adult body vestiture:

with few scales (glabrous) (0); with scales (many, hairy) (1)

This character is quite labile in its states. Although there tends to be a rather continuous range of scale-coverage on baridine adults, from few scales to a thick

covering, many taxa may also be relatively glabrous on most of their derm, while dense scale patches may exist in only a few specific locations. Entirely glabrous baridine species are relatively rare, and so in terms of this study, glabrous is interpreted as possessing few scales or minute scales that may be present in each puncture on the derm.

Rostrum:

5. rostrum, base - head-rostrum junction:

smooth, rostrum flush with outline of head in lateral view (0); a groove/bump separating rostrum from head (1)

The junction at which the rostrum intersects the head is often produced into a small cleft, in which the margins of the head and rostrum abruptly meet (Fig. 10), but it may be smooth and flush when the dorsal margin of the rostrum connects to the head at a higher position (Fig. 11). It some cases it is difficult to distinguish these two states, because this junction may be slightly concave, alluding to a reduced groove, but is smooth.

6. rostrum, setae along ventral margin (males only):

absent (0); present (1)

Elongate setae along the apico-ventral margin of the rostrum are only present in a few taxa in Baridinae, and they are only present in males (Fig. 13).

7. rostrum, shape, lateral view:

enlarged basally (0); width sub-equal along entire length (1); wide basally, gradually narrowing apically (2)

While most taxa possess a rostrum that is wide basally and gradually narrows apically (Fig. 11), some have a rostrum that is expanded or enlarged basally, abruptly narrowing later, or entirely cylindrical and subequal (Fig. 12).

8. rostrum, shape, lateral view:

robust, short (0); narrow, long (1)

This character can be particularly ambiguous given the large amount of variation in rostrum lengths and widths. In general, a short rostrum is much shorter than the longitudinal length of the pronotum, usually ¾-1/2 the length of the pronotum. Long generally applies to a rostrum which is equal in length to or longer than the pronotum.

9. rostrum, curvature:

straight (0); broadly curved (1); strongly curved (2)

Characterizing the curvature of the rostrum can be quite difficult. No ambiguity is faced when the rostrum is straight or sublinear. The point at which the rostrum changes from being broadly curved to strongly curved usually is not obscure. Most genera possess a rostrum which is broadly curved. Rostra which are strongly

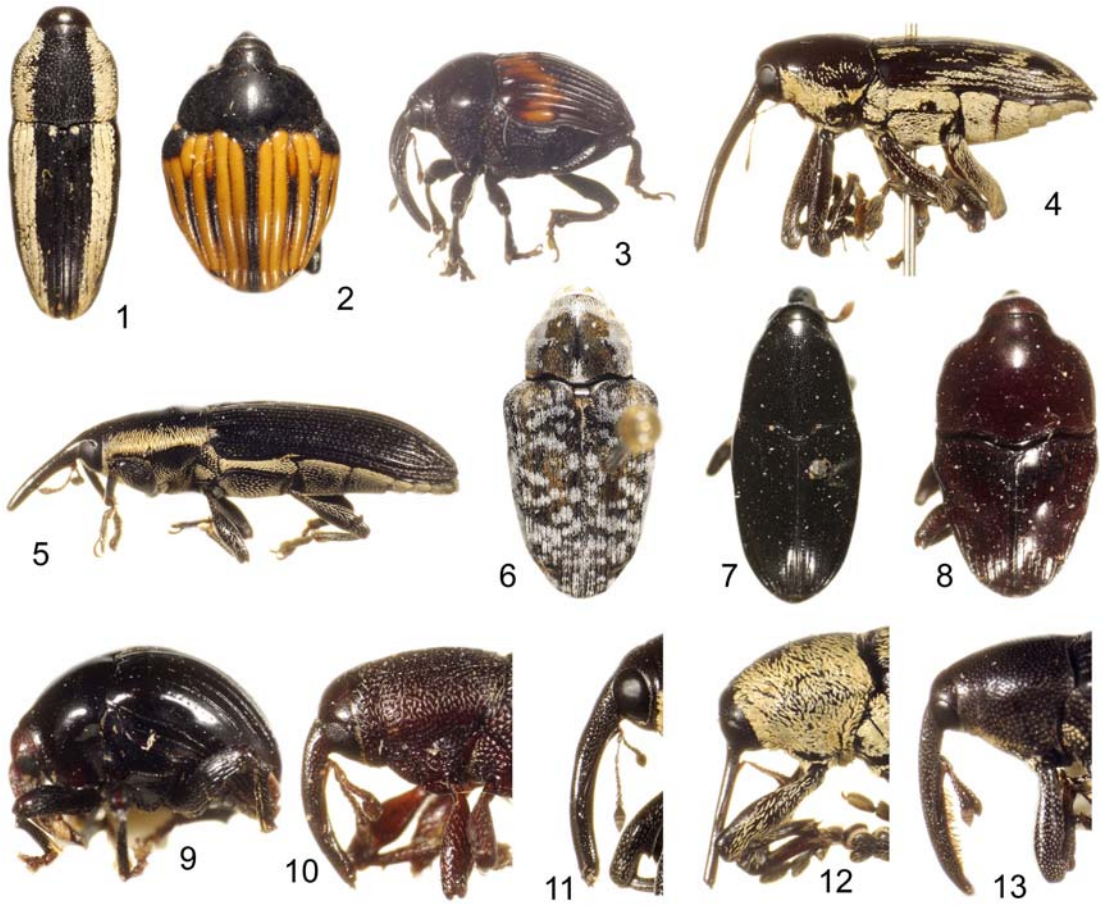
curved often are not elongate or greater in length than that of the pronotum, and the apex of the rostrum nearly is recurved underneath the prosternum in habitus.

Antenna:

10. antenna, insertion:

along basal half (0); along apical half (1); at middle (2)

Antennal insertion along the basal or apical half is not difficult to distinguish; however, insertion along the middle usually allows for a small error range. Thus, antennae which may be inserted slightly or immediately before or after the middle are also characterized as being inserted at the middle.



11. antenna, number of funicular articles:

6 (0); 7 (1); 3 (2)

The number of funicular articles in Baridinae is always 6, while outgroups possess varying numbers.

12. antenna, number of club articles:

4 (0); 3 (1)

The number of club articles in Baridinae varies between 3 (Figs. 16, 17) and 4 (Figs. 14, 15), as do the outgroups.

13. antenna, club:

round, globous, compact (0); elongate (1); normal (2); club absent, moniliform articles (3)

All baridines possess an antennal club. The shape of the club can be summarized into 3 forms: all of the articles may be short and compact (Figs. 14-17); the articles may be elongate, an extreme state of the length of the articles; somewhere in between these two states is the typical form of the baridine club, in which the articles typically are not compacted but are slightly longer. Only select outgroups may not possess a club.

14. antenna, funicle-club complex:

distinctly separate (club large, funicle narrower) (0); uniform (club + funicle similar in width) (1); uniform (club + funicle similar in width), more compact (2)

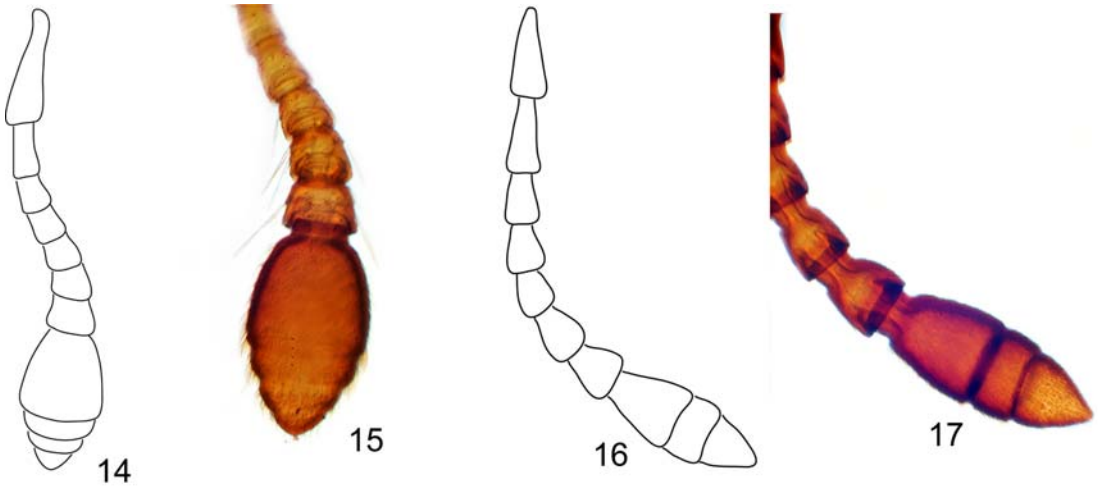
Associated with the club condition, though not dependent, is the shape form by the association of the funicle and club. Often when the club articles are short and compact, though not always, the funicular articles may also be compact and relatively wide, approximately similar in width to the club and forming a smooth lateral margin where at the funicle-club junction (Fig. 14). This condition may be slightly reduced, where the articles are more loosely compact and do not form a smooth margin upon

intersection with the club (Fig. 16). The funicular articles may also be somewhat moniliform, elongate (not compact), and narrow, in which the club often is notably larger than the funicle.

15. antenna, length of club segments:

short (0); long (1)

This character often highly correlates with char. 13, though it is useful in distinguishing clubs with short or long articles. A compact club always is composed of short articles (Fig. 14), and an elongate club always is composed of long articles; however, the club of intermediate size may be composed of short or long articles.



16. antenna, scape:

close to but not reaching anterior margin of compound eye (0); surpassing anterior margin of compound eye (1); distant from anterior margin of compound eye (2); touching eye (3)

Baridinae always possess a scape which does not surpass the anterior margin of the eye. Variation is observed in how distant or close it is situated from the eye. When distant from the eye, it always reaches within the basal half of the rostrum and is never further. The scape typically is falls close to the eye but not touching it, and in some taxa it actually meets the surface of the compound eye's anterior margin.

Mouthparts:

17. mandibles, dentition:

monodentate (molar region fused with primary incisor) (0); "monodentate", with a small tooth near apex of larger tooth (1); bidentate, with 2 large, apical teeth, and a molar region (2); tridentate, with 3 large, apical teeth, and a molar region (3); bidentate without distinct molar region (4); tridentate without distinct molar region (5); monodentate without distinct molar region (6)

The mandibles in Baridinae are divided into an incisor region and a molar region. Mandibles may display two forms of monodentatation, one in which the mandible possesses a distinct molar region (Fig. 18-22), and the other which may have the molar region fused with the incisor (Fig. 23) and the dentation lost. Mandibles may also bear two incisors (Fig. 21) or three incisors (Figs. 18-20, 22).

Only outgroups have mandibles which may lose the molar region or may possess mandibles in which molar and incisor regions are indistinct.

18. mandibles, incisor size:

primary incisor largest (0); secondary incisor largest (1); teeth subequal (2)

Regarding incisor size, the primary incisor may be largest in both forms of monodentate mandibles (Fig. 23) or in bidentate (Fig. 21) or tridentate mandibles (Figs. 18, 22). In bidentate or tridentate mandibles, the secondary incisor may be largest (Fig. 20), or the teeth may be subequal in size (Fig. 19). The relative size of the incisors may be subject to error in some cases.

19. mandible, shape:

linear (0); curved (1)

This character indicates direction and orientation of the primary incisor. The primary incisor may be oriented linearly in mono-, bi-, or tridentate mandibles (Figs. 22, 23). The primary incisor is always linear in monodentate mandibles, but may be curved in bi- or tridentate mandibles (Figs. 18-21).

20. maxilla, palpiger - setae along central region:

absent (0); present, many arranged in a bunch (1); present, many arranged in a horizontal line (2); present, few restricted to outer corner (3)

The orientation of setae on the palpiger may be in a distinct, transverse line (Figs. 24, 25), a dense, random grouping throughout the palpiger (Fig. 26), or a sparse, small grouping largely restricted to the antero-lateral margin (Figs. 27, 28).

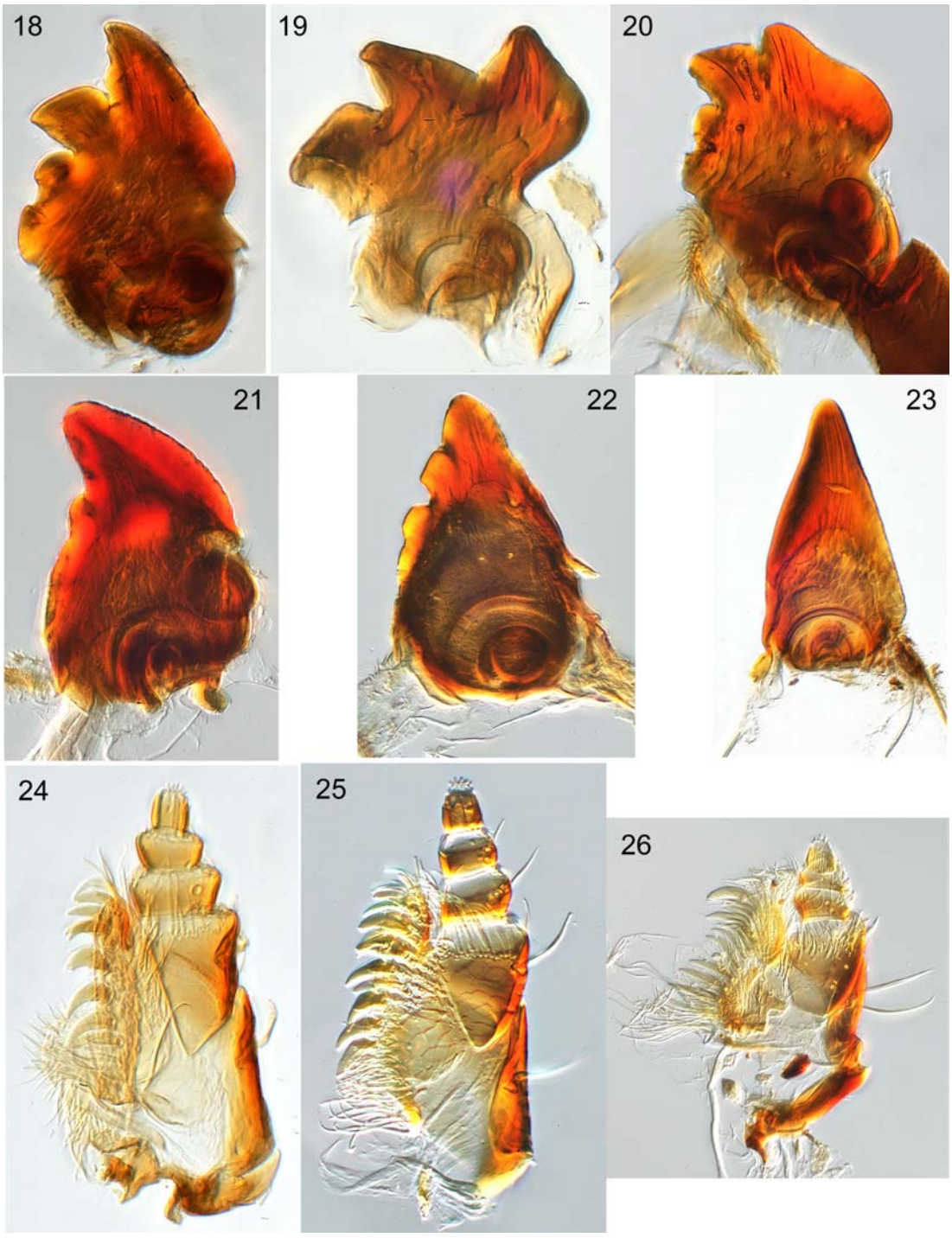
21. labium, prementum - setae near distal margin:

setae arranged in a bunch (0); setae arranged in a horizontal line (1); absent (2)

Similar to the maxilla, setal orientation may be in a distinct, transverse line (Fig. 29, 30) or randomly scattered, forming no specific orientation (Fig. 31, 32).

22. labium:

palps short, base large (0); palps long, base small (1); palps highly reduced, base large (2); palps highly reduced, base normal (3)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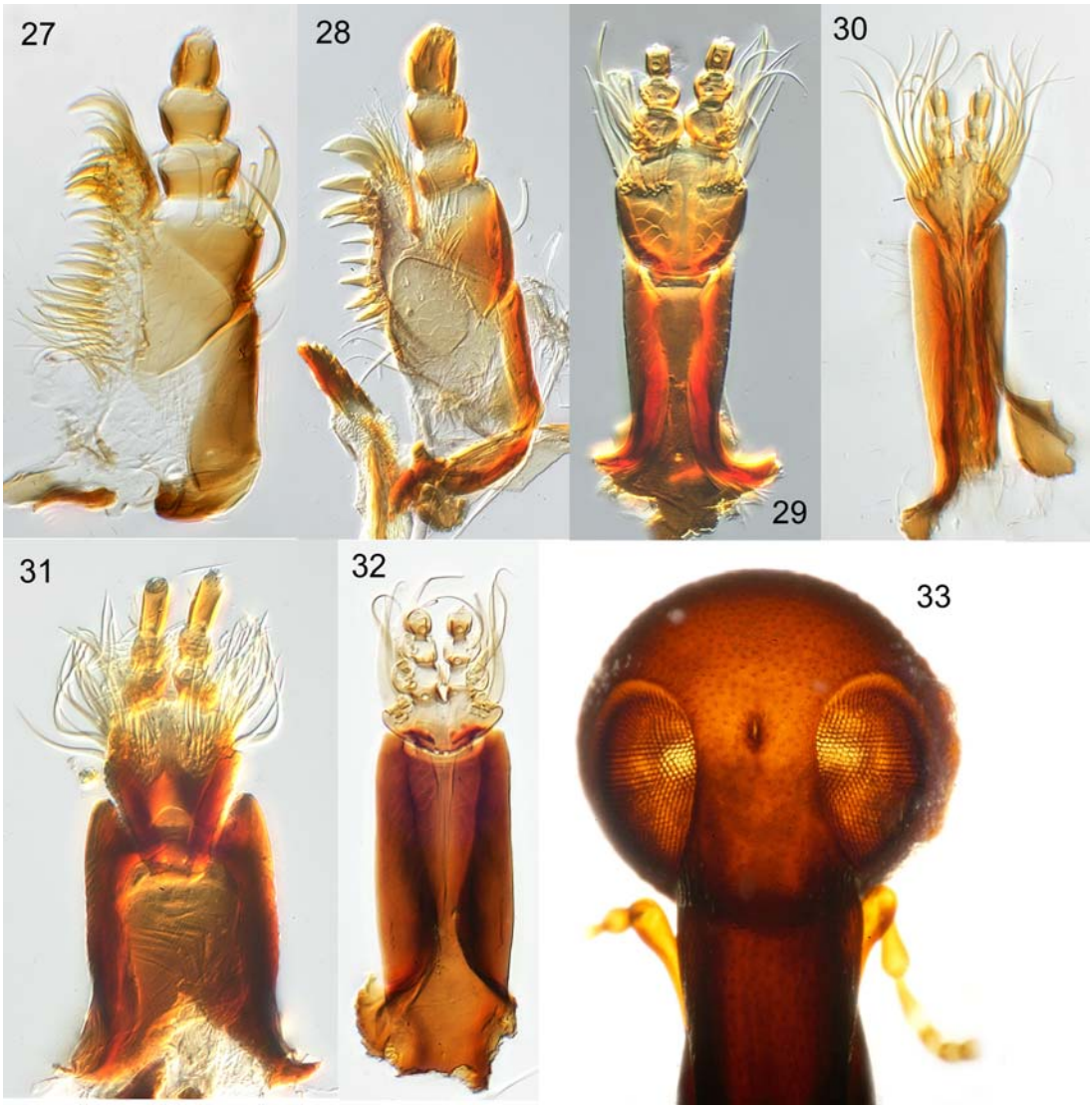
Although there is much variation in palpal length, baridines generally possess a fairly short labial palpus (in relation to the size of the postmentum), however many genera also possess shortened palpal segments, which may or may not be accompanied by an enlargement of the postmentum, or slightly elongate palpal segments, which may or may not be accompanied by a reduction of the postmentum.



Head:

23. head, rostrum - foramen between eyes on frons:

present (0); absent (1)

In most baridines, the frons is relatively smooth (except for the punctures), but some taxa possess a small hole/foramen at the center of the frons (Fig. 33).

24. compound eyes:

elongate, along antero-ventral surface (0); round, large, along anterior surface (1); teardrop-like, large, along anterior surface (2); round, bulging, along antero-ventral surface (3); round, along antero-ventral surface (4)

The majority of baridines have an elongate compound eye. In many outgroups, and in a few baridines, the eye may be round or sub-circular. Also in the outgroups, the eyes may to teardrop-shaped (Conoderinae) or round and bulging from the head (Ceutorhynchinae).

Prothorax:

25. prothorax:

normal, proportional to abdomen (0); enlarged (1)

The prothorax may be proportional in size to the abdomen (and elytra), often smaller than the abdomen (Figs. 6, 7), or it may be enlarged (Fig. 8).

26. thorax, pronotum - puncture collar near anterior margin:

absent (0); present, with small punctures (1); present, with large punctures (2)

Along the collar, particularly in baridines, there is a row of punctures. The punctures may be enlarged and deep (Figs. 34, 35) or small and reduced in size and depth (Fig. 36). In a restricted number of baridines, but mostly in the outgroup, this puncture collar is often absent.

27. thorax, prosternal horns in males:

present, long, with invagination simple (0); absent (1); present, with invagination bifurcate (2); present, long, with invagination reduced/absent (3); present, horns very reduced, invagination reduced/absent (4); present, horns fused (with invagination simple) (5)

Often associated with the prosternal horns in males (Fig. 37) is a deep invagination between the horns (Fig. 38). This invagination may be simple (Fig. 39), bifurcate (Fig. 40), or may be reduced in size to absent (Figs. 43, 45). The size of the horns also varies, from short (Fig. 42) to long (Figs. 41, 44), as does their structure.

28. thorax, pronotum - longitudinal smooth line along middle of pronotum:

absent, punctures scattered evenly throughout pronotal surface (0); present (1)

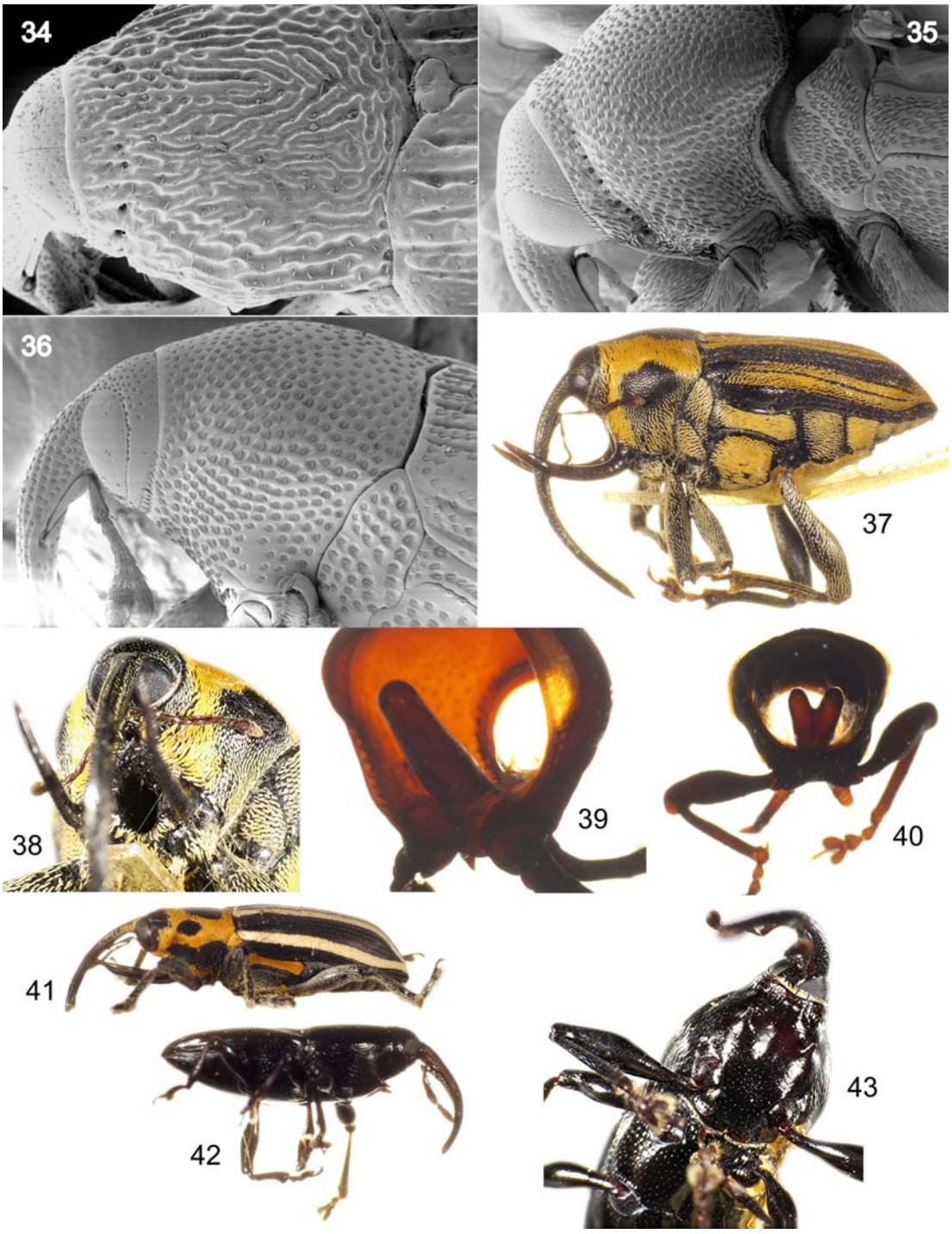
The majority of baridines possess a longitudinal smooth line along the middle of the pronotum which is absent of punctures. This line may be present (Fig. 47) or absent (Fig. 46).

29. thorax, pronotum - mid-dorsal hump:

absent (0); present (1)

The pronotum may have a produced swelling (Fig. 48), although it often is not present.

30. thorax, pronotum - vestiture (scales):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absent (0); present, only along outer margins, with middle bare (1); present, evenly distributed along surface (2)

The vestiture on the pronotum may be such that scales are evenly distributed along the surface or are restricted to the lateral margins.

31. thorax, pronotum – sculpturing:

round punctures (0); elongate ridges (1)

Punctures on the pronotum usually are round or elliptical (Fig. 36), though sometimes they form irregular, longitudinal ridges (Fig. 34).

32. thorax, pronotum - shape of posterior margin:

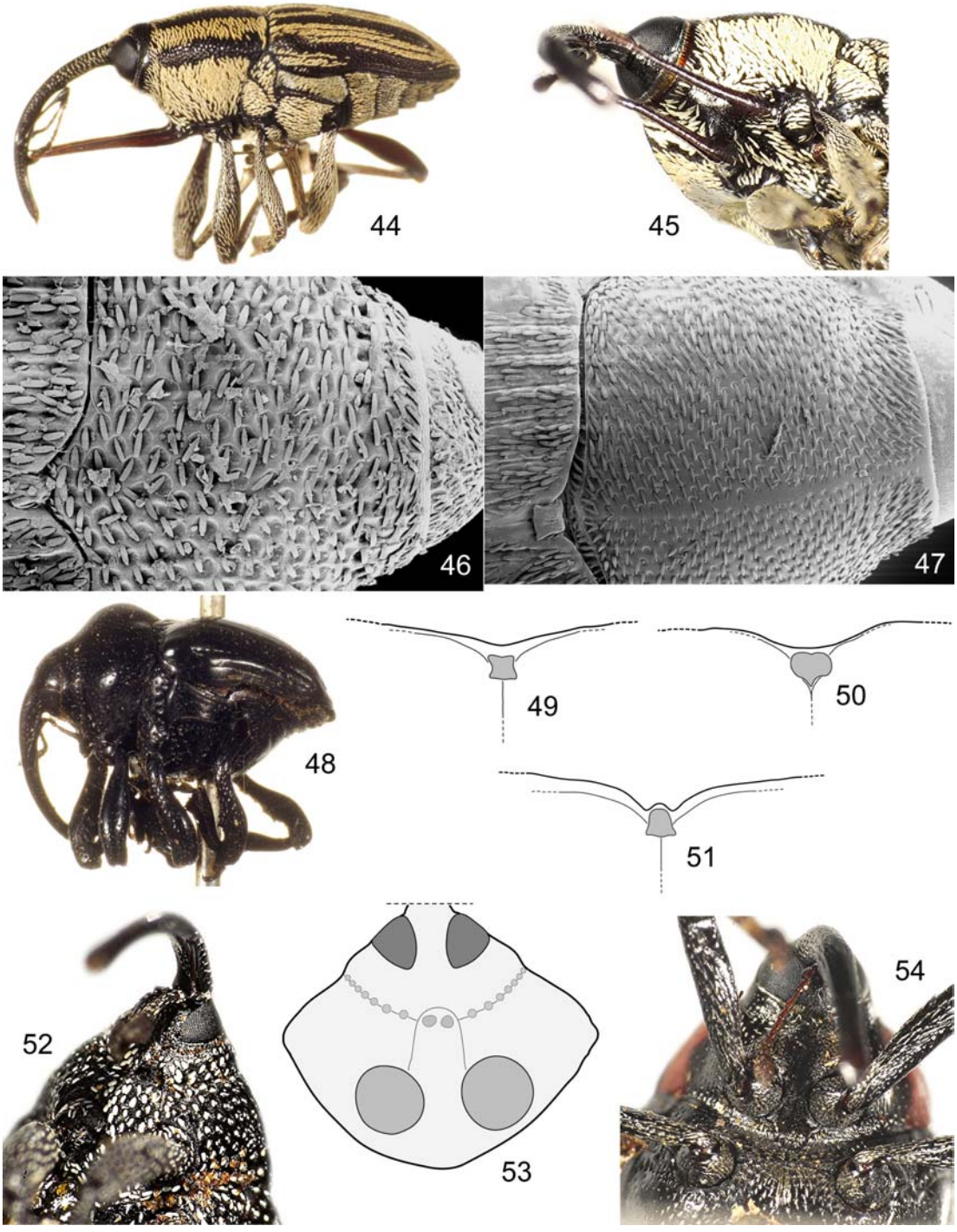
broadly round, convex (no protrusion at middle) (0); convex protrusion at middle (1); convex protrusion at middle - protrusion with concavity (2)

The posterior margin of the pronotum typically has a convex protrusion (Fig. 50) which may have a small concavity in the center (Fig. 51). Many outgroup taxa, including a few baridines, possess a fairly straight posterior margin (Fig. 49).

33. thorax, prosternum - ventral canal for reception of rostrum:

present (0); absent (1); only shallow depression (2)

The prosternum may possess a clearly-defined ventral canal or it may be absent. Sometimes, however, there is a shallow depression on the prosternum which may be indicative of a highly reduced canal.



34. thorax, prosternum - ventral depression along collar:

present (0); absent (1)

This depression is present in most taxa and is accompanied by small, lateral carina (Figs. 52, 53).

35. thorax, prosternum - holes along side of ventral collar depression:

present (0); absent (1)

When a puncture collar is present, the ventral-most pair of punctures may be particularly enlarged and deep.

36. thorax, mesosternal process:

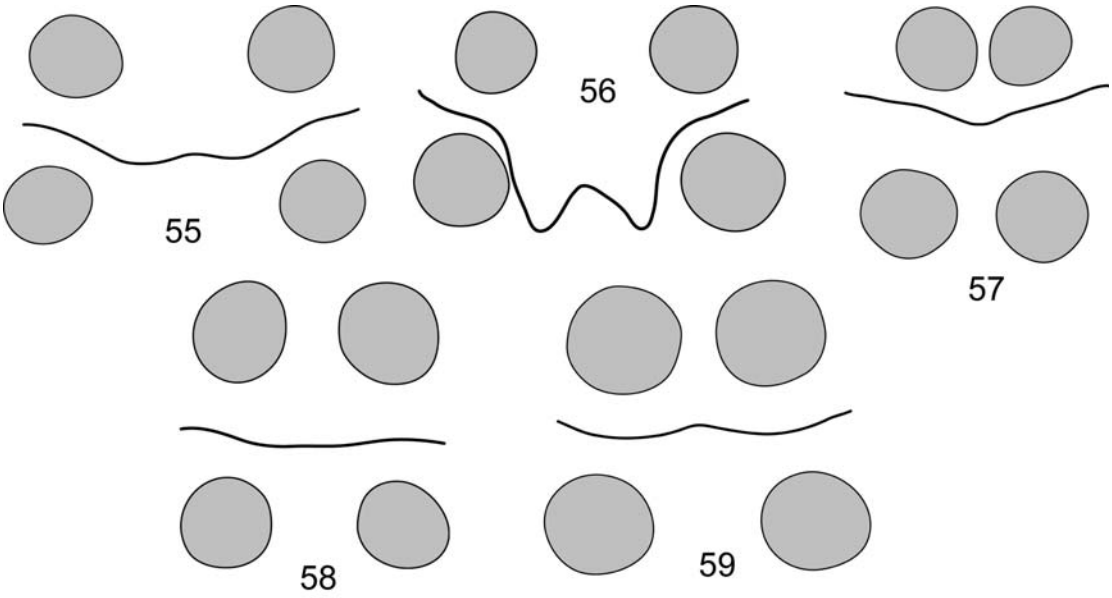
reduced (0); developed, quadrate, posterior margin straight (1); developed, V-shaped (2); developed, posterior margin with slight concavity (3); with small notch, quadrate (4); pointed (5); reduced (6)

The mesosternal process (Fig. 54) may be produced to quadrate with the posterior margin straight or concave (Figs. 55, 59), V-shaped (Fig. 56), with a small, median notch, pointed (Fig. 57), or reduced and relatively straight (Fig. 58).

Coxae:

37. pro-coxae, inter-coxal distance:

pro-coxae separated by < 1x diameter of coxa (0); pro-coxae separated by ~1x diameter of coxa (1); pro-coxae separated by >1x diameter of coxa (2); pro-coxae touching (3)



38. meso-coxae, inter-coxal distance:

pro-coxae separated by <1x diameter of coxa (0); pro-coxae separated by ~1x diameter of coxa (1); pro-coxae separated by >1x diameter of coxa (2)

39. meta-coxae, inter-coxal distance:

pro-coxae separated by ~1x diameter of coxa (0); pro-coxae separated by >1x diameter of coxa (1); pro-coxae separated by <1x diameter of coxa (2)

Thorax:

40. thorax, mesosternal concavity for reception of rostrum:

absent (0); present (1)

When a ventral canal is present in baridines, it is only present on the prosternum and never reaches the mesosternum. Only outgroup taxa have this character present.

41. thorax, mesepimeron:

not ascended (not visible from dorsad) (0); ascended (visible from dorsad) (1)

42. thorax, sclerolepidia:

absent (0); present (1); present, reduced/very small (2)

When sclerolepidia are present, they may be relatively large and noticeable or highly reduced (this latter state usually occurs when the derm is largely glabrous).

43. thorax, sclerolepidia – shape:

flat, small (0); projecting, large (1); absent (2); feather-like, hair-like (3); multi-furcate, stringy (4)

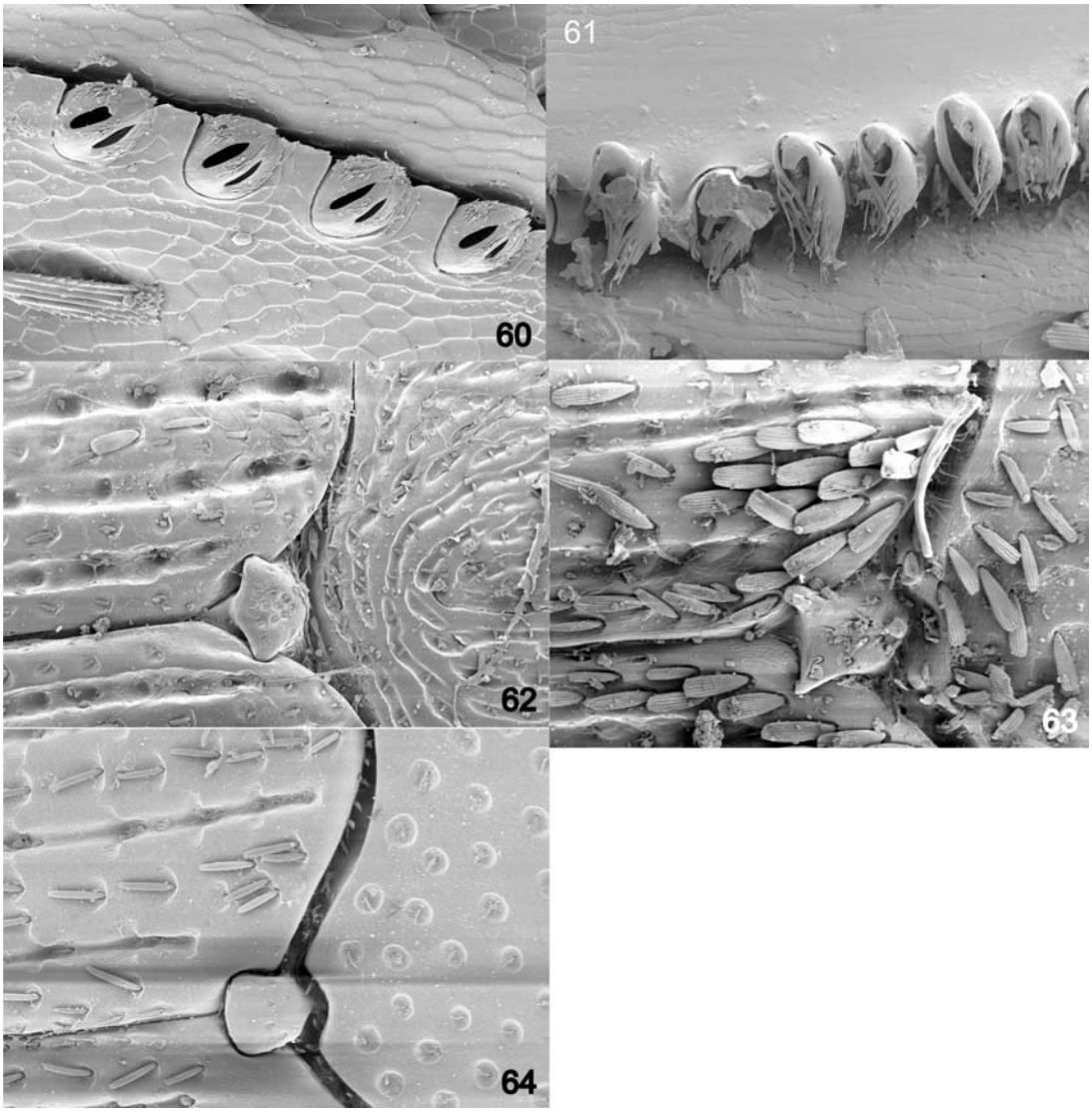
Only baridines possess the sclerolepidia of states 0 (Fig. 60) and 1 (Fig. 61), and the outgroups have different types (Lyal *et al.* 2006).

Mesonotum:

44. mesonotum, scutellum - shape of posterior margin:

round (0); heart-shaped, with a cleft at middle (1); concave (2); acute (3); quadrate (4); concave with central projection (5); round with central projection (6)

The anterior and posterior margins of the mesoscutellum form many shapes and are difficult to homologize. In general, the posterior margin may be broadly round (Fig. 64), broadly round with a central projection (Fig. 62), with a cleft in the middle, concave (Fig. 63), acute,



quadrate, or concave with a central projection. Although these states are discrete, the difference between two states may often be subtle.

45. mesonotum, scutellum - shape of anterior margin:

acute (0); broadly round (1); quadrate (2); heart-shaped (3); concave (4)

The anterior margin of the mesoscutellum, similar to the posterior margin, may form many shapes. The variation in shape of the anterior margin, however, appears less than that of the posterior margin, although the same subtly appears sometimes between states. In general, the anterior margin may be broadly round, acute, quadrate, cardiform or with a cleft in the middle, or concave.

46. mesonotum – posterior margin:

acute, with broadly concave margins (0); rounded, projecting, with abruptly concave margins (1); flat, no protrusion (2); quadrate protrusion (3)

Baridinae only possess states 0 and 1, where the posterior margin is triangular, having concave antero-lateral margins. States 2 and 3 occur in the outgroups, where the posterior margin may not be produced at all and is relatively flat and truncated, or it may form a quadrate protrusion. In Baridinae, when the antero-lateral margins of the mesonotum are broadly concave, the posterior margin forms an acute apex (Figs. 65, 66). When the antero-lateral margins are more deeply concave, the posterior margin forms a more projecting apex.

47. mesonotum – punctures:

only along anterior margin of notal process (0); throughout notal process (1); absent (2)

In Baridinae, the mesonotum usually bears punctures on the mesothoracic phragma. These punctures may either be scattered along the phragma or restricted to the posterior margin of the phragma.

48. mesonotum - posterior margin of mesothoracic phragma:

with small notch/V-shape at longitudinal suture (0); no notch at longitudinal suture (1); no notch, with 2 concavities (2)

Along the posterior margin of the mesothoracic phragma, a notch or small invagination may be present at the posterior apex of the longitudinal suture (Fig. 65). Alternatively, this notch may be absent, where the posterior margin of the phragma is smooth and continuous (Fig. 66).

Metanotum:

49. prescutum - ventral margin:

middle concavity shallow, not reaching ventral margin (0); middle concavity deep, reaching ventral margin (1); shallow and triangular (2); no concavity, lobes absent (3)

The pair of lobes on the anterior margin of the prescutum may have a shallow concavity (Fig. 67) or a deep concavity that reaches the anterior margin of the prescutum (Fig. 68). In some cases this pair of lobes may be absent.

50. metanotum, scutellar groove - transverse bridge:

absent (0); present, reduced (1); present, developed (2)

The transverse bridge near the anterior margin of the scutellar groove that may occasionally be present appears to only occur in Baridinae. It may be fully developed (Figs. 69, 70, 73), reduced (Fig. 71, 74), or absent (Fig. 72).

51. metanotum, scutellar groove - longitudinal crest:

absent (0); present, reduced (1); present, developed (2); absent, with many bumps/ridges (3)

The longitudinal crest along the middle of the scutellar groove also appears to be apomorphic to baridines, though it becomes lost several times. When present, it may be developed and enlarged (Figs. 69, 72) or reduced and small (Figs. 70, 71). When absent, the scutellar groove may bear small ridges along the midline or be smooth.

52. metanotum, scutellar groove - lobe at anterior end:

round, convex, smooth (0); with concavity at middle (1); with quadrate protrusion (2); straight (3); pointed (4)

The lobe at the anterior end of the scutellar groove may be simple and broadly convex, relatively straight (Fig. 73), or bilobed (Fig. 69). Only in the outgroups is it found to be pointed.

53. metanotum, scutellar groove - posterior margin:

straight (0); concave (1); convex (2)

The posterior margin of the scutellar groove will often be concave when it protrudes from the metascutellum (Fig. 69), straight when it is relatively flush with the posterior margin of the metascutellum (Fig. 73), or convex when it ends before the posterior margin of the metascutellum (Fig. 72).

54. metanotum, postnotum - lateral margin:

with acute, projecting lobe (0); without lobe, margin broadly rounded (1)

The lateral margins of the postnotum always bear a projecting lobe in Baridinae (Figs. 69-74), and this lobe is absent in most outgroups, leaving the lateral margin straight.

55. metanotum, metascutellum - line reaching from metascutum to alacrista:

absent (0); present (1)

In many baridine taxa, a slight, angled ridge or line may be present on the metascutellum (Fig. 69) or may be absent (Fig. 72).

56. metanotum, metascutum - posterio-medial margin:

straight, shallowly concave (0); concave (1); convex (2); quadrate (3)

In Baridinae, the posterio-medial margin of the metascutum may be relatively straight (Fig. 72), concave (Fig. 73), or convex (Figs. 69, 70). A characteristic of many outgroup taxa is a quadrate shape of this margin.

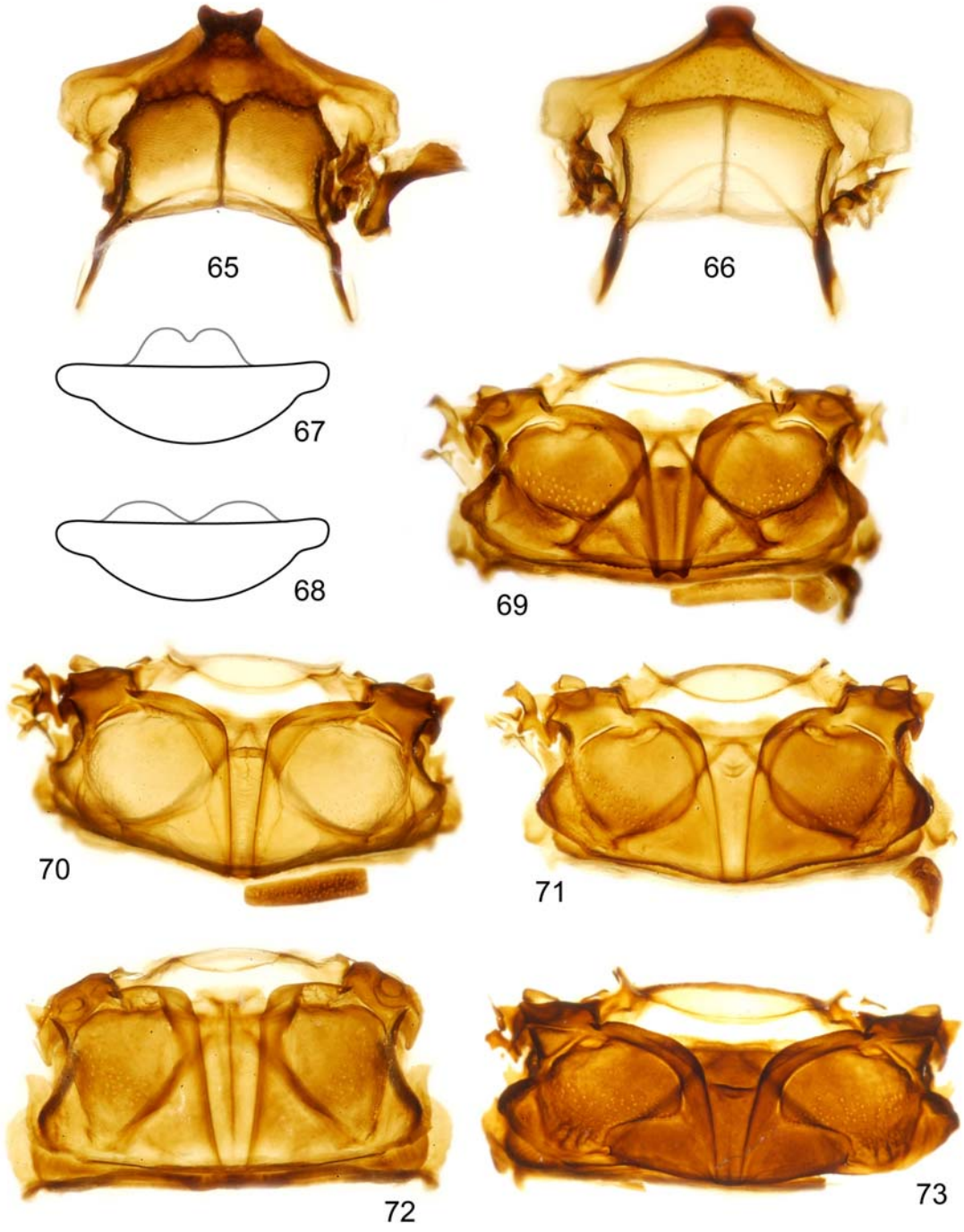
57. metanotum, metascutum - posterior margin:

with definite margin separating it from postnotum (0); with indefinite margin; merging with postnotum (1)

In Baridinae, the metascutum may be well-defined, with a distinct posterior margin separating it from the postnotum and/or the metascutum is widely separate from the postnotum (Fig. 69). Alternatively, the metascutum may have an indistinct margin, in which the metascutum appears more elongate and/or the posterior margin of the metascutum is narrowly separated from the postnotum (Figs. 70-74).

58. metanotum, metascutum – punctures:

large (0); small (1); none (2)



The metascutum may bear large punctures, small punctures, or may be absent of punctures.

59. metanotum, metascutum – shape:

transversely elongate (0); round (1); longitudinally elongate (2)

The shape of the metascutum is moderately correlated with body shape (width and length), though is not entirely indicative. The metascutum may be transversely elongate (Figs. 69, 73), round to subcircular (Figs. 70, 71), or longitudinally elongate (Figs. 72, 74). The different between round and elongate sometimes is not completely objective.

Metendosternite:

60. metendosternite - longitudinal suture:

long (0); short (1)

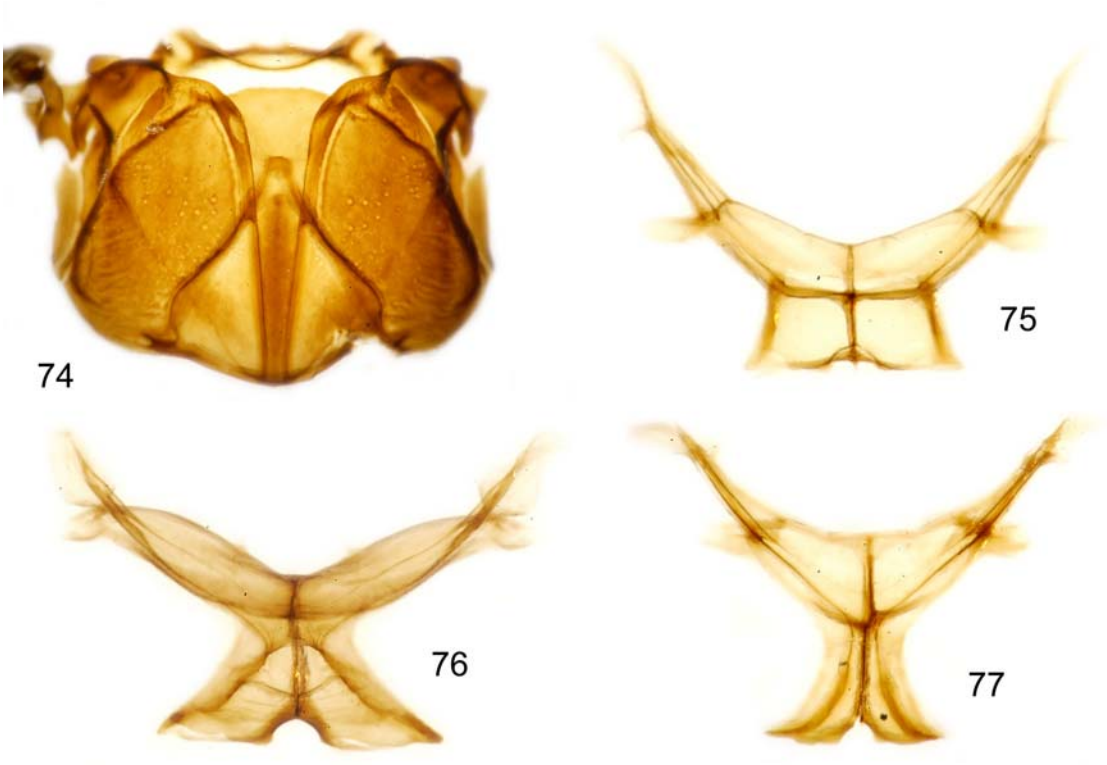
A long longitudinal suture (Figs. 75, 77) is often indicative of a quadrate metendosternite shape, though not always, and the same for a short longitudinal suture (Fig. 76) and longitudinally elongate metendosternite.

61. metendosternite - metafurcal arm:

bifurcate (0); monofurcate (1)

62. metendosternite - metafurcal lamina:

longitudinally elongate (0); quadrate (1); transversely elongate (2)



The metafurcal lamina may be longitudinally elongate (Figs. 76, 77), relatively quadrate or square (Fig. 75), or transversely elongate.

63. metendosternite - anterior metafurcal tendons:

closer to longitudinal suture (0); closer to metafurcal arm (1); in middle (2)

64. metendosternite, shape:

quadrate (transversely or longitudinally quadrate) (0); longitudinally elongate, metafurcal lamina elongate & curved (1)

Although similar to the shape of the metafurcal lamina, the general shape of the metendosternite is divided into those taxa bearing a metendosternite with quadrate angles along the margins of the metafurcal lamina (this includes lamina which are square and longitudinally or transversely quadrate) (Fig. 75) and those taxa in which the lateral margin of the lamina becomes constricted along the middle and concave (Figs. 76, 77).

65. metendosternite, lateral arm:

normal, produced (0); reduced, small (1)

Most Baridinae possess a large, produced lateral arm (Figs. 75-77), though a few, including many outgroup taxa, bear a small and reduced lateral arm.

Legs:

66. thorax, legs - Pre-tarsal ungues (claws):

connate, parallel (0); separate, diverging (1); only 1 claw present (2); separate, with 2 large central teeth (3); separate, widely diverging (4)

Most baridines possess connate (Figs. 80, 81) or separate/diverging (Fig. 82) pre-tarsal ungues, though a few have widely diverging ungues with nearly 180° separating them or have only a single ungue. Only outgroup taxa (Conoderinae, Ceutorhynchinae) have ungues which bear central teeth.

67. thorax, legs - mid femoral spine on all legs:

present, one spine present (0); absent (1); present, two or more spines present (2)

68. thorax, legs - ventral surface of femora with depression for reception of tibia:

present (0); absent (1)

Many baridines possess a variably-defined depression along the ventral surface of the femora. The depression ranges from being quite shallow and reduced (depression restricted to basal third of femur) to relatively deep and extending most of the length of the femur. This variation, however, is grouped into a single state, present. When the femur is completely cylindrical then the depression is absent.

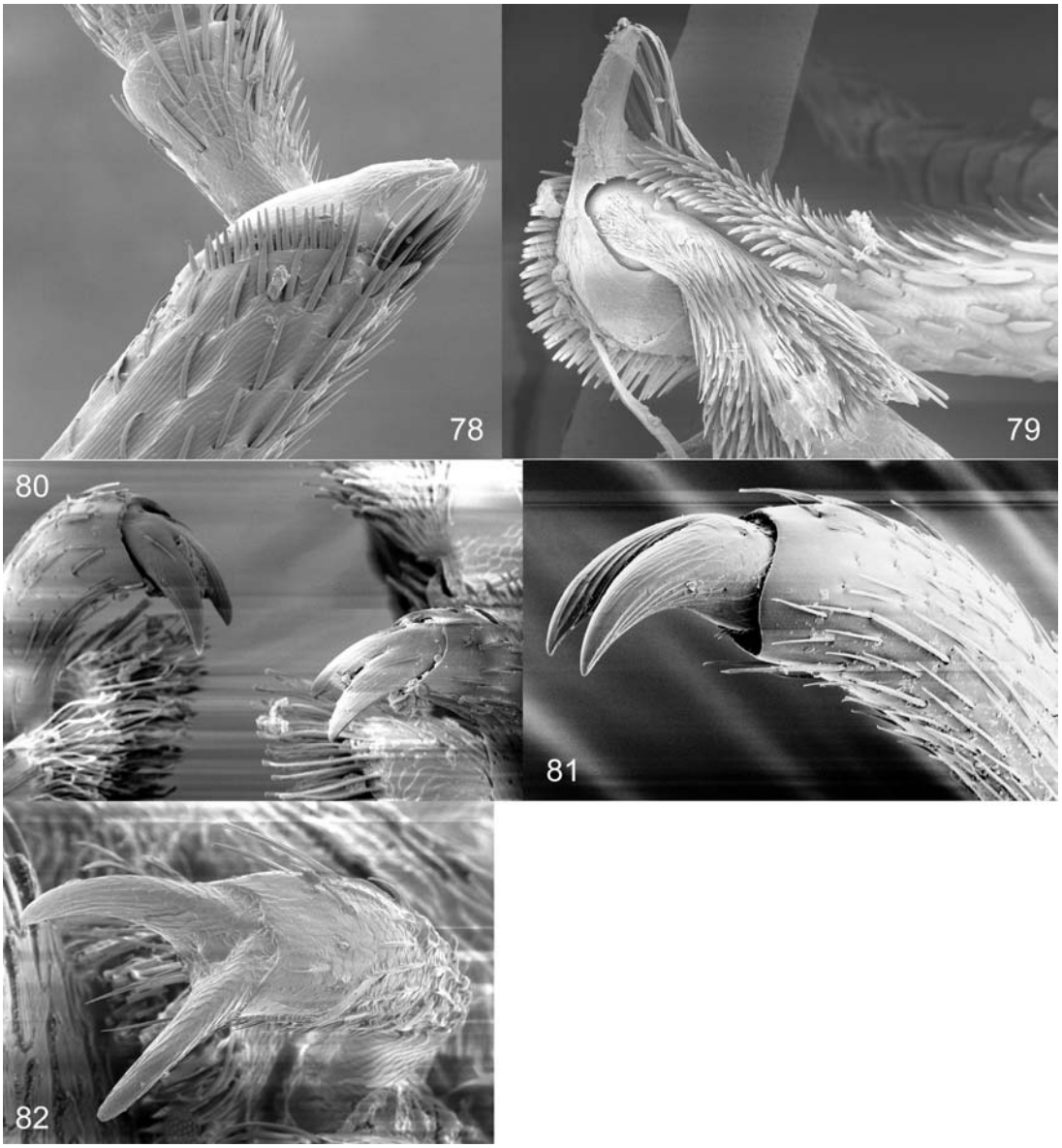
69. thorax, legs - apical tibial spines:

with 2 apical teeth, diverging on opposite corners (0); 1 large uncus at other corner (1); with 1 apical spine and 1 setal spine converging at one corner (2); with 2 apical spines, 1 large uncus in middle and smaller on corner (3); with no spines (4); with many spines (5); with 1 large uncus at middle (6)

Most baridines possess one large uncus at the outer apical angle (along with an adjacent tuft of elongate setae that are convergent with the uncus) (Figs. 78, 79). In some taxa the tibia may have two apical teeth of approximate size (the mucro on the inner apical angle and the uncus at the outer apical angle), the uncus on the inner apical angle (a shift in position from the typical outer apical angle), the uncus at the middle of the apex and the mucro at the outer apical angle, or no apical teeth at all.

Outgroups possess tibiae with several apical spines or the uncus at the middle of the apex and the mucro absent.

70. tarsus, bilobed 3rd tarsomere:



small, reduced (5th tarsomere usually elongate) (0); enlarged (5th tarsomere usually normal size) (1); normal size (2)

When the third tarsomere is small, the fifth tarsomere usually also is elongate, and when it is enlarged or expanded, the fifth tarsomere usually is shortened. It often is difficult to distinguish the intermediate (normal) sized third tarsomere from the two extreme states.

Hind wings (Figs. 83-86):

71. wing, venation - R3:

absent (0); present with dark vein (1); present with white strip (2); wing reduced or absent (3)

72. wing, venation – 2rs:

absent (0); present (1); wing reduced or absent (2)

73. wing, venation - mst:

developed (0); reduced (1); wing reduced or absent (2); absent (3)

74. wing, venation - rm:

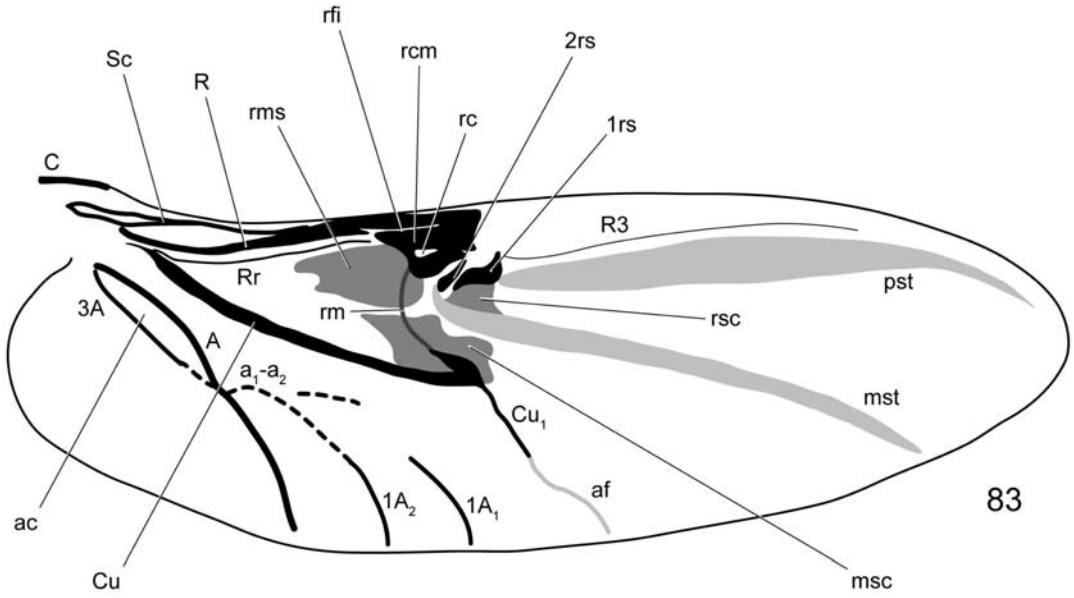
absent (0); present (1); wing reduced or absent (2)

75. wing, venation - $1A_1$:

absent (0); present (1); wing reduced or absent (2)

76. wing, venation - $1A_2$:

absent (0); present (1); wing reduced or absent (2)



77. wing, venation - 1A:

absent (0); present (1); wing reduced or absent (2)

78. wing, venation - 3A:

absent (0); present, reduced (1); present, nearly connected with 4A (2); wing reduced or absent (3)

79. wing, venation - Rr:

absent (0); present (1); wing reduced or absent (2)

Elytra:

80. thorax, elytra - Intervals:

with more than 1 row of punctures (0); 1 row of punctures (1); no punctures (2); ridges present (3)

The elytral intervals typically are either flattened, in which case they may be smooth, bear punctures, or have developed ridges absent of punctures. Puncture orientation may be categorized as forming a single row (Fig. 88) or not forming defined rows but with a dense scattering (Fig. 87).

81. thorax, elytra - Hump (at apical area where many striae converge):

absent (0); present, small (1); present, large (2)

The size of the posterior elytral hump is difficult to characterize. In general, it may be absent, present and small, or present and large.

82. thorax, elytra - position over abdomen:

covering abdomen completely (pygidium not visible) (0); pygidium partially or completely visible (1)

83. elytra, apical margin – shape:

elytra forming acute apex (0); elytra forming rounded apex (thereby exposing pygidium) (1)

The apices of the elytra may form congruent edges, in which the lateral margins of both elytra join (or nearly meet) at their acute apices. This condition often is associated with complete enclosure of the pygidium by the elytra, though not always. The other condition, which often is associated with exposure of the pygidium, is when the apices of the elytra are produced into lobes and are rounded.

Abdomen, ventrites:

84. abdomen, ventrites - Lateral margins of ventrite 2:

arched (0); straight (1)

In Baridinae, the lateral margins are always arched. Only outgroups may possess straight lateral margins.

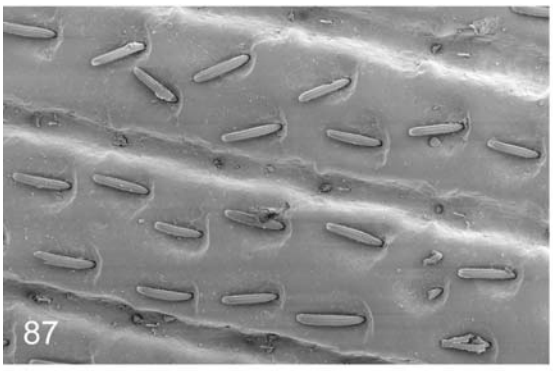
85. abdomen, ventrites - Posterior margin of ventrite 1:

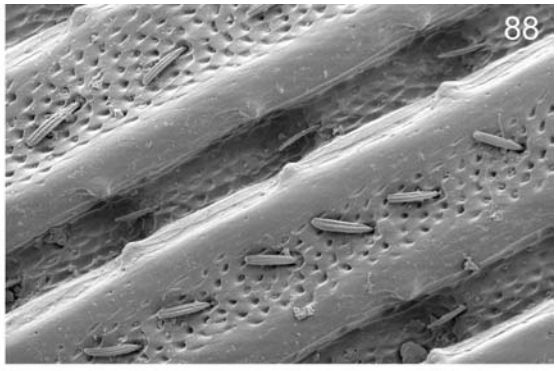
linear (0); sinusoidal (1); broadly round (2)

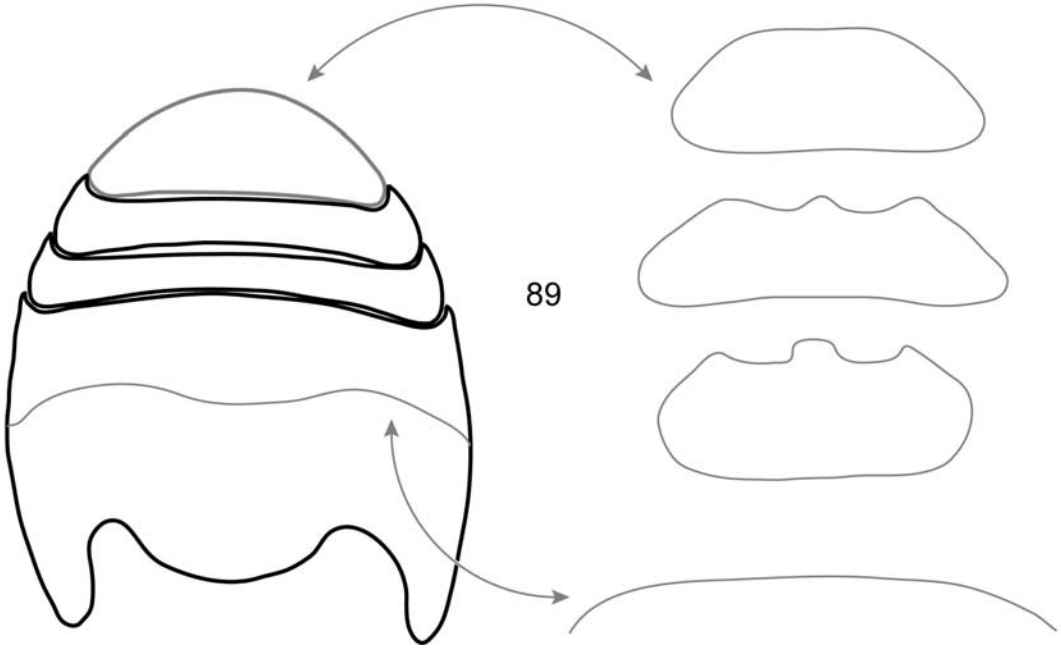
Most baridines possess a sinusoidal posterior margin of ventrite 1 (Fig. 89), though this margin may sometimes be straight or broadly curved.

86. abdomen, ventrites - Posterior margin of ventrite 5:

rounded (0); truncate, broadly curved (convex) (1); truncate, sinusoidal (2); truncate, concave (3); truncate, sinusoidal with central projection (4); quadrate (5)







The posterior margin of ventrite 5 may be variously shaped. It may be rounded (Fig. 89), truncate but still convex, truncate and sinusoidal which may sometimes have a central projection or knob, truncate and concave, or quadrate.

87. abdomen, ventrites - Punctures along anterior margin of ventrite 5:

absent, margins smooth (0); present (1)

Although punctures usually are present on the ventrites, they particularly may be present along the anterior margin of ventrite 5, or they may be absent, in which this margin is smooth.

Abdomen, tergites:

88. abdomen, tergites - Sclerotization of tergites:

lightly sclerotized, almost membranous (0); heavily sclerotized (1)

When the tergites are strongly sclerotized they maintain a rigid convexity (Figs. 90, 95-97). When the tergites are weakly sclerotized they collapse and become shriveled *post mortem* (Fig. 98).

89. abdomen, tergites - central spiculate patches of central tergites (Figs. 90-92):

absent (0); on tergites 2-6 (1); on tergites 3-6 (2); on tergites 4-6 (3); on tergites 5-6 (4); 6 (5); 1-6 (6)

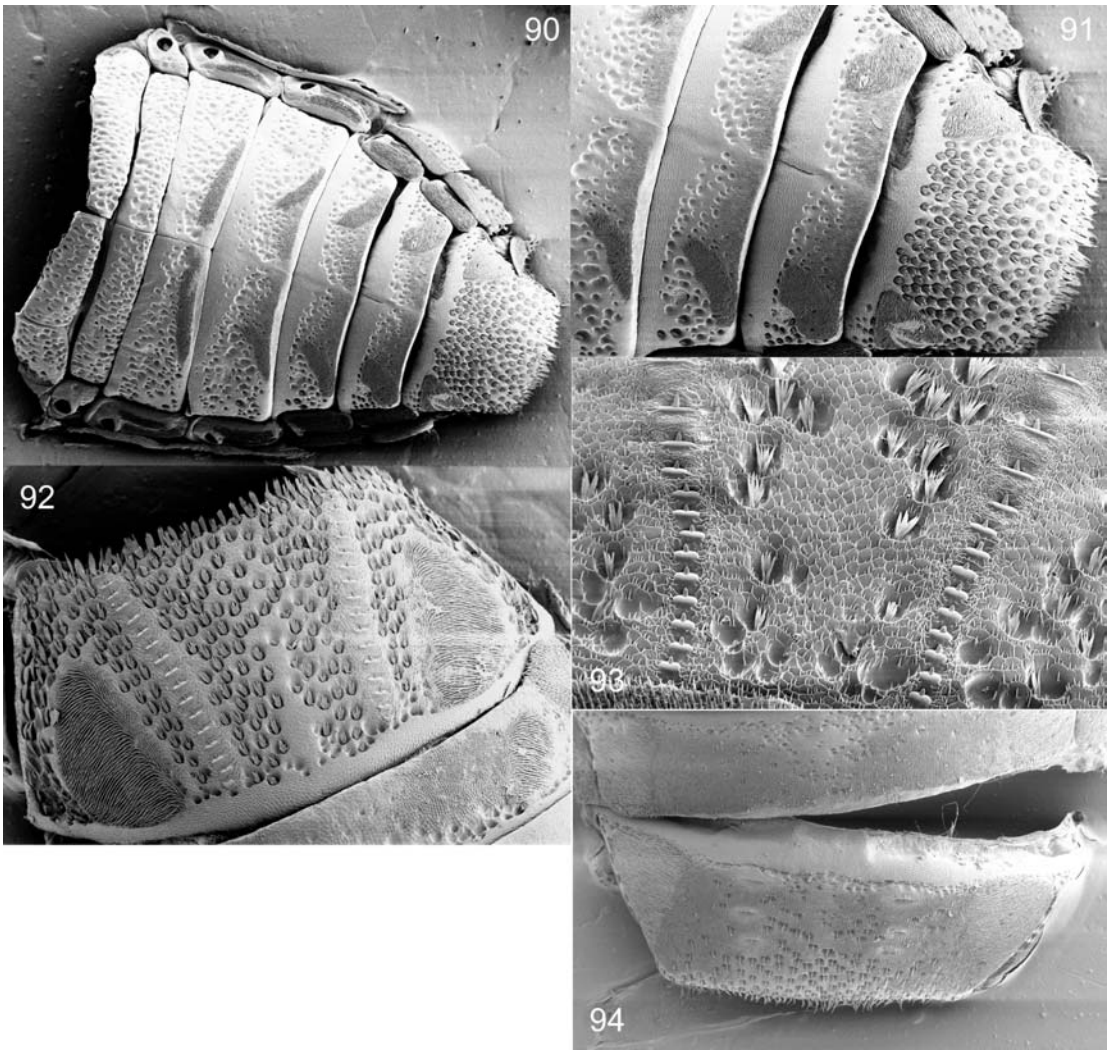
See Chapter V for baridine spiculate patch morphology.

90. abdomen, pygidium (tergite 7) - Plectral tubercles:

present, sparse (0); absent (1); present, dense (2)

When plectra are present on tergite 7 (of males and females) they may form dense rows (Figs. 92-93) or more sparse rows (Fig. 94). These different plectral densities correspond to morphologically disctinct file types on the inner apical margin of the elytra. The males were used for character coding, as females almost always exhibit reduced plectral development.

91. abdomen, pygidium (tergite 7) - with longitudinal median line/crest:



absent (0); present (1)

When a longitudinal median line is present on tergite 7, it may extend the full length of the tergite or be restricted to the anterior half.

92. abdomen, central tergite 1:

fused (0); separated (1)

93. abdomen, central tergite 2:

fused (0); separated (1)

94. abdomen, central tergite 3:

fused (0); separated (1)

95. abdomen, central tergite 4:

fused (0); separated (1)

96. abdomen, central tergite 5:

fused (0); separated (1)

97. abdomen, central tergite 6:

fused (0); separated (1)

98. abdomen, lateral tergite 1:

fused (0); separated (1)

99. abdomen, lateral tergite 2:

fused (0); separated (1)

100. abdomen, lateral tergite 3:

fused (0); separated (1)

101. abdomen, lateral tergite 4:

fused (0); separated (1)

102. abdomen, lateral tergite 5:

fused (0); separated (1)

103. abdomen, lateral tergite 6:

fused (0); separated (1)

104. abdomen, tergites - lateral spiculate patches of central tergites (Fig. 90):

on tergites 2-7 (0); on tergites 3-7 (1); on tergites 4-7 (2); on tergites 5-7 (3); on tergites 6-7 (4); only on tergite 7 (5); 1-7 (6)

See Davis (2008b) for baridine spiculate patch morphology.

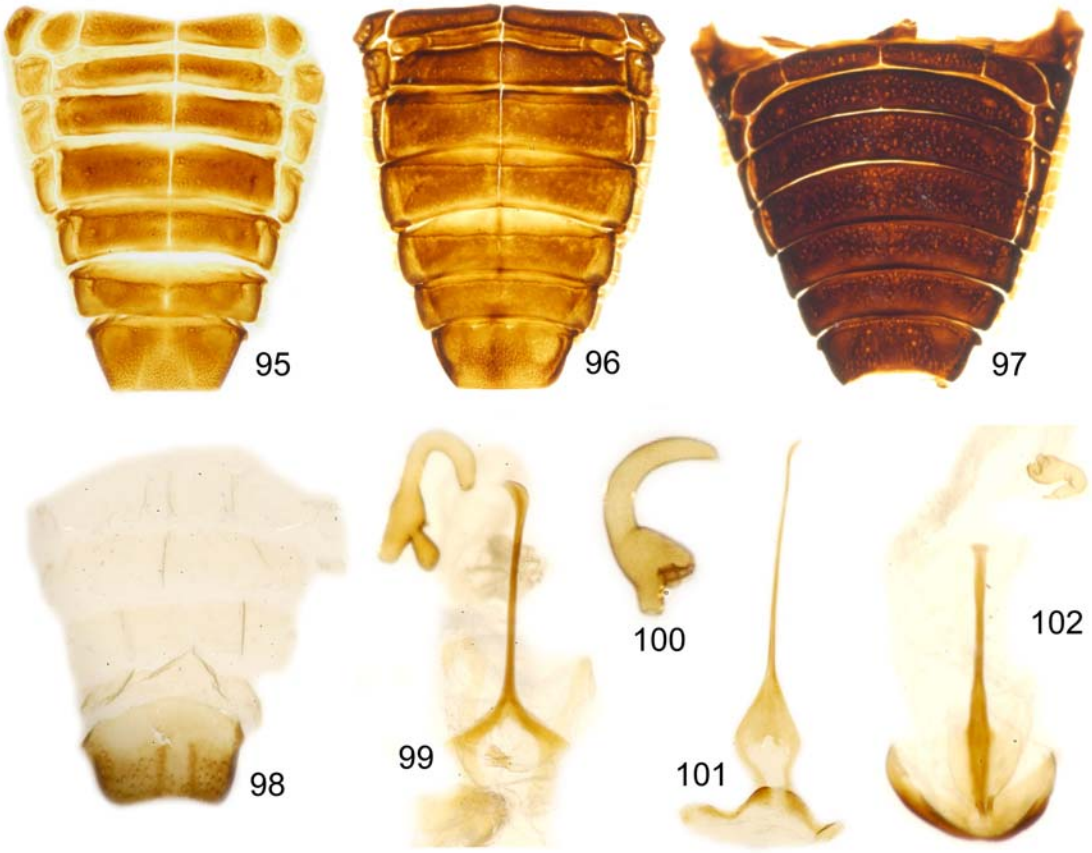
Female genitalia:

105. female, 8th sternite - lateral margin:

with acute angle (0); with rounded angle (1)

The basal antero-lateral margins of the female 8th sternite may be quadrate and angular (Fig. 99) or rounded to reduced or nearly absent (Figs. 101, 102).

106. female, spermatheca:



with ramus and collum present (0); only collum present (ramus reduced or absent) (1)

The spermatheca may have both ramus and collum present (with the ramus often developed and elongate) (Fig. 99) or the ramus may be highly reduced or absent (Fig. 100).

Male genitalia:

107. male, aedeagus - internal flagellum:

absent (0); present (1)

An internal flagellum may be present (Figs. 107, 108) or absent.

108. male, aedeagus – median struts:

very short, highly reduced (0); ~as long as aedeagus (1); longer than aedeagus, thin (2)

There is enormous variation in length in the median struts, most being approximately equal in length to the aedeagus (Figs. 103, 105), though they may be highly reduced and shortened (Fig. 104) or several times longer than the aedeagus (Figs. 106-108).

109. male, aedeagus – median orifice:

large (0); slightly restricted (1); nearly fused basally (2); opening restricted to apex, fused basally (3)

Most baridines possess a median orifice that is enlarged and opening up to the anterior margin of the median lobe (Figs. 106, 108), and in which the lateral sides of the median lobe are moderately slender. The lateral margins of the median lobe may also be nearly fused (Fig. 103) or completely fused (Fig. 105) forming an enclosed median orifice. Somewhat intermediate between these is a slightly restricted orifice, in which the lateral sides of the median lobe are wide but not to the point of nearly fusing at the anterior end (Fig. 107). This intermediate state may be difficult to distinguish from the completely open state of the median orifice.

110. male, aedeagus - apical margin:

concave (0); acutely rounded (1); with small rounded projection (2); round, globular (3)

The apex of the median lobe may be broadly rounded (Fig. 105), acute (Fig. 103), with a central lobed projection, or concave (Fig. 106). Occasionally the apex may be narrowly rounded, falling in between states 1 and 3, and in these cases the taxon was coded as having an acute apex.

111. male, 9th sternite - apex of spiculum gastrale:

normal, subequal in width (0); expanded and flattened (1)

The apex of the spiculum gastrale may be straight and bear no modification, but it often bears a hood-like expansion (Fig. 109).

112. male, tegmen – ventral strut:

monofurcate, narrow (0); bifurcate (1); monofurcate, wide (2); absent (3); very reduced (4)

The ventral strut often is narrow and elongate in Baridinae, but may be wide, reduced in length, or bifurcate.

Phylogenetic methods

Parsimony analyses with full dataset

The full data matrix, consisting of 113 characters and 301 taxa, was compiled in WinClada (Nixon 1999b). Phylogenetic analyses were performed using NONA (Goloboff 1999) and TNT (Tree analysis using New Technology; Goloboff *et al*. 2003). In NONA, two alternative styles were used for ratchet runs (Nixon 1999a) during tree exploration. One ran single ratchet sets for 4,000 iterations while sampling 35 to 50 characters and holding 1 tree per iteration. The second style was utilizing multi-ratchet sets. One set of runs used 2 simultaneous threads and 10 sequential ratchet runs, performing 200 iterations per run while sampling 35 to 45 characters and holding 1 tree per iteration. Another set of runs used 2 simultaneous threads and 20 sequential ratchet runs, performing 100 iterations per run while sampling 35 characters and holding 1 tree per iteration.

Runs in TNT consisted of implementing sectorial searches (SS) with tree drifting (TD) and tree fusing (TF) and ratchet runs with TD and TF. The final strict

consensus tree was computed using TNT by implementing 500 random addition sequences, and 1,000 ratchet iterations, including 100 cycles of both TD and TF per iteration.

Reduced taxon matrix (RTM)

A reduced taxon dataset, including all 113 characters, but only 140 taxa, was constructed. To do so, exemplar taxa were included from all baridine tribes and subtribes, and all taxa with approximately 50% missing data (due to the inability to dissect type specimens) were removed from the dataset, which did not interfere with obtaining a relatively reasonable sampling from each tribe and subtribe. All outgroup taxa in the full dataset were included in the RTM. The final run was performed in TNT and was conducted using the same settings and procedures as used in the final analysis of the full dataset (see above). Additionally, one of the most-parsimonious trees found is reported for better topological clarity (Fig. 117), as a few of the major nodes collapsed in the strict consensus (Fig. 116).

Clade support analyses

Bootstrap analyses performed using TNT gave similar results to jackknife runs, and also due to results in previous studies that have reported greater utility of jackknifing to bootstrapping in morphological studies (Hovenkamp 2006), only jackknife values are reported. Previous studies also have preferred bootstrapping over jackknifing because of the uncertainty in percentage of characters (or taxa) to

delete during replications (Soltis and Soltis 2003). Also, because bootstrapping assesses group support in a slightly different manner, by analyzing re-sampled matrices of the same size, and jackknifing assesses more of progress towards obtaining stable results by directly eliminating characters (or taxa) from the analyses (thus inferring the effect on tree topology if more characters were added; Siddall 1995), jackknifing seemed more appropriate for attempts towards a first phylognetic hypothesis. Jackknife runs were performed using TNT. Final jackknife values were obtained by implementing 100 random addition sequences, and 1,000 ratchet iterations, including 100 cycles of both TD and TF per iteration.

Bremer support values (both absolute and relative) were calculated in TNT. Using the most-parsimonious trees obtained from the final TNT parsimony run, 10,000 trees within 15 steps of the MP tree were searched for and retained.

Character tracing

Characters of interest and those supporting the monophyly of Baridinae were selected to trace their evolution on the resulting cladogram in WinClada. In each case, tracing was performed under fast optimization (ACCTRAN). These characters include 41 (ascension of the mesepimeron, Fig. 125), 46 (posterior margin of mesonotum, Fig. 122), 54 (lateral margin of postnotum, Fig. 123), and 98 (fusion of lateral tergites, Fig. 124). Although not shared among all Baridinae, character 88 (tergite sclerotization) was also traced (Fig. 121).

Character weighting using implied weights

Character weighting using Goloboff's (1997) implied weights was performed in TNT with both the complete dataset and RTM for varying values (2, 4, 6, 8) of the weighting strength or concavity constant K. Runs in TNT consisted of 100 random addition sequences, and 1,000 ratchet iterations, including 100 cycles of both TD and TF per iteration.

Bayesian analyses

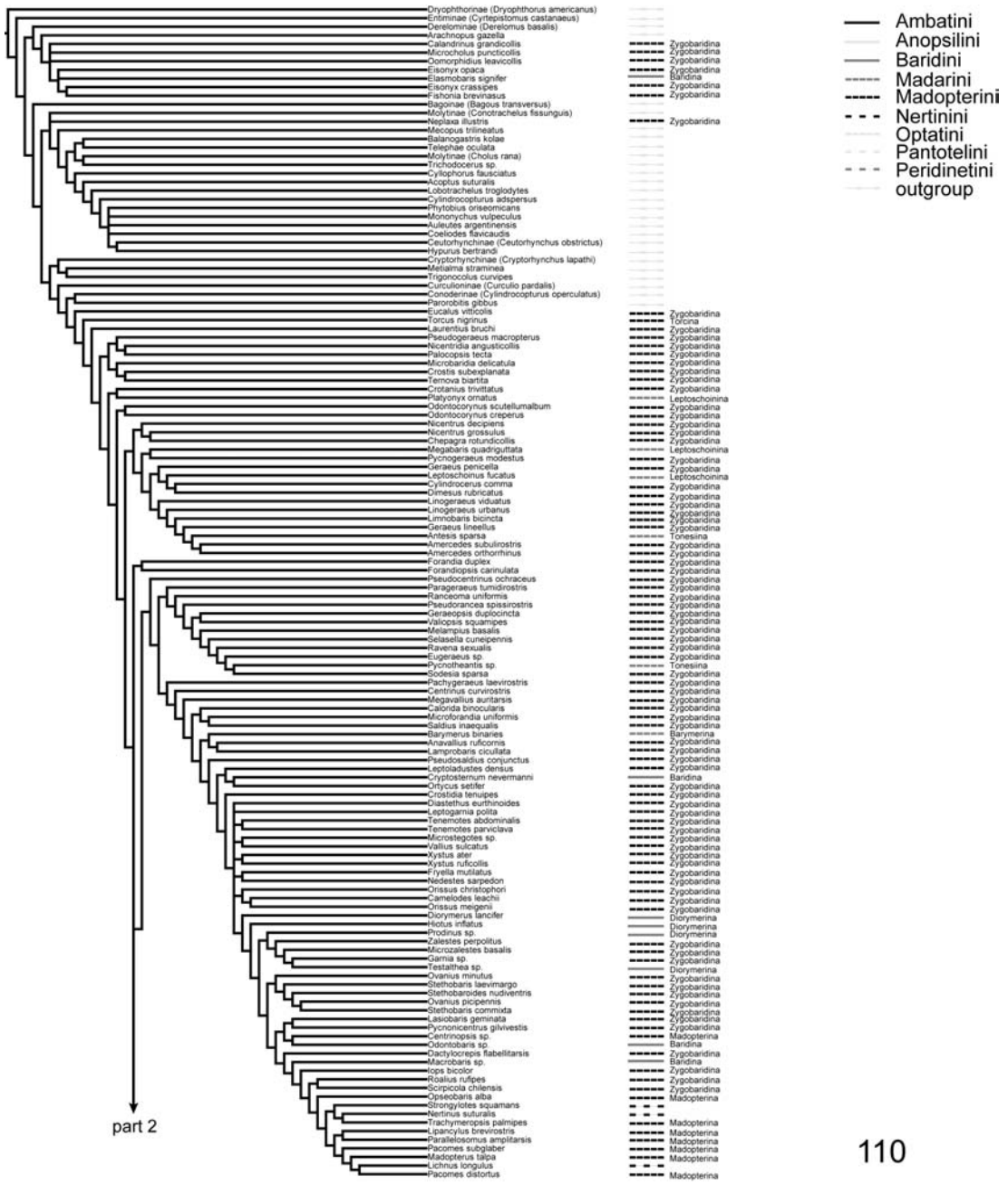
Bayesian analyses were conducted with both the full dataset and the RTM using the MrBayes software (Ronquist and Huelsenbeck 2002). All runs were performed using the standard discrete (morphology) model (derived from Lewis 2001) using the default settings with 4 chains, except the character sampling coding was set to "variable." Also, a run of 3 million generations was executed for both datasets, and another run of 10 million generations was executed using only the full dataset. Burn-ins consisted of 300,000 generations for the 3 million generation runs and 1,000,000 for the 10 million generation run. The program Tracer software (Ramber and Drummond 2004) was used to construct plots of parameter diagnostics, namely the log likelihoods of the trees (LnL) and the tree lengths (TL).

Results

Strict consensus

The duration of the final TNT run was ~37 hours, and the total rearrangements examined was 3,930,947,747,326. A strict consensus tree (Fig. 111) was calculated from 33 most-parsimonious trees of length 4,509 and Ci=5, Ri=51. The length of the consensus tree is 4,850, with Ci=4, Ri=48. The considerably longer length of the strict consensus is largely due to the poor resolution in the large polytomy present at the apex of the tree. The absolute and relative bremer support values for each clade of the full tree and RTM tree are given in Fig. 111, and jacknife values of 50 and greater are also reported. Characters and character states are mapped onto the branches of the strict consensus tree under fast optimization (Fig. 112), slow optimization (Fig. 113), and showing unambiguous changes only (Fig. 114).

The duration of the RTM run was considerably shorter, a mere ~1.6 hours, and the total rearrangements examined was 135,442,242,201. A strict consensus tree was calculated from 110 most-parsimonious trees of length 2,692. Similar to the strict consensus of the complete analysis, characters and character states for the RTM tree are mapped onto the branches of the strict consensus tree under fast optimization (Fig. 118), slow optimization (Fig. 119), and showing unambiguous changes only (Fig. 120).


Dryophthorinae (Dryophthorus americanus)
Entiminae (Cyrtepistomus castanaeus)
Dereliminae (Derelomus basalis)
Arachnopus gazella
Calandrinus grandicollis
Microcholus punctricollis
Oomorphidius leavicollis
Eisonyx opaca
Elasmobaris signifer
Eisonyx crassipes
Fishonia brevinasus
Bagoinae (Bagous transversus)
Molytinae (Conotrachelus fissunguis)
Neplaxa illustris
Mecopus trilineatus
Balanogastris kolae
Telephae oculata
Molytinae (Cholus rana)
Trichodocerus sp.
Cyllophorus fausciatus
Acoptus suturalis
Lobotrachelus troglodytes
Cylindrocopturus adspersus
Phytobius oriseomicans
Mononychus vulpeculus
Auleutes argentinensis
Coeliodes flavicaudis
Ceutorhynchinae (Ceutorhynchus obstrictus)
Hypurus bertrandi
Cryptorhynchinae (Cryptorhynchus lapathi)
Metialma straminea
Trigonocolus curvipes
Curculioninae (Curculio pardalis)
Conoderinae (Cylindrocopturus operculatus)
Pararobitis gibbus
Eucalus vittcollis
Torcus nigrinus
Lauretitus bruchi
Pseudogeraeus macropterus
Nicentridia angusticollis
Palocopsis tecta
Microbaridia delicatula
Crostis subexplanata
Ternova biartita
Crotanius trivittatus
Platyonyx ornatus
Odontocorynus scutellumalbum
Odontocorynus creperus
Nicentrus decipiens
Nicentrus grossulus
Chepagra rotundicollis
Megabaris quadriguttata
Pycnogeraeus modestus
Geraeus penicella
Leptoschoinus fucatus
Cylindrocerus comma
Dimesus rubricatus
Linogeraeus viduatus
Linogeraeus urbanus
Limnobaris bicincta
Geraeus lineellus
Antesia sparsa
Amercedes subulirostris
Amercedes orthorrhinus
Forandia duplex
Forandiopsis carinulata
Pseudocentrinus ochraceus
Parageraeus tumidirostris
Ranceoma uniformis
Pseudorancea spissirostris
Geraeopsis duplocincta
Valiopsis squamipes
Melampius basalis
Selasella cuneipennis
Ravena sexualis
Eugeraeus sp.
Pycnotheantis sp.
Sodesia sparsa
Pachygeraeus laevirostris
Centrinus curvirostris
Megavallius auritarsis
Calorida binocularis
Microforandia uniformis
Salidius inaequalis
Barymerus binaries
Anavallius ruficornis
Lamprobaris ciculiata
Pseudosalidius conjunctus
Leptoladustes densus
Cryptosternum nevermanni
Ortycus setifer
Crostidia tenuipes
Diastethus eurthinoides
Leptogamia polita
Tenemotes abdominalis
Tenemotes parviclava
Microstegotes sp.
Vallius sulcatus
Xystus ater
Xystus ruficollis
Fryella mutilatus
Nedestes sarpedon
Orissus christophori
Camelodes leachii
Orissus meigenii
Diorymerus lancifer
Hiotus inflatus
Prodinus sp.
Zalestes perpolitus
Microzalestes basalis
Garnia sp.
Testalthea sp.
Ovanius minutus
Stethobaris laevimargo
Stethobaroides nudiventris
Ovanius picipennis
Stethobaris commixta
Lasiobaris geminata
Pycnonicentrus gilvivestis
Centrinopsis sp.
Odontobaris sp.
Dactylocrepis flabellitarsis
Macrobaris sp.
Iops bicolor
Roalius rufipes
Scirpicola chilensis
Opseobaris alba
Strongylotes squamans
Nertinus suturalis
Trachymeropsis palmipes
Lipancylus brevirostris
Parallelosomus amplitarsis
Pacomes subglaber
Madopterus talpa
Lichnus longulus
Pacomes distortus
Zygobaridina
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Baridina
Zygobaridina
Zygobaridina
Zygobaridina
Torcina
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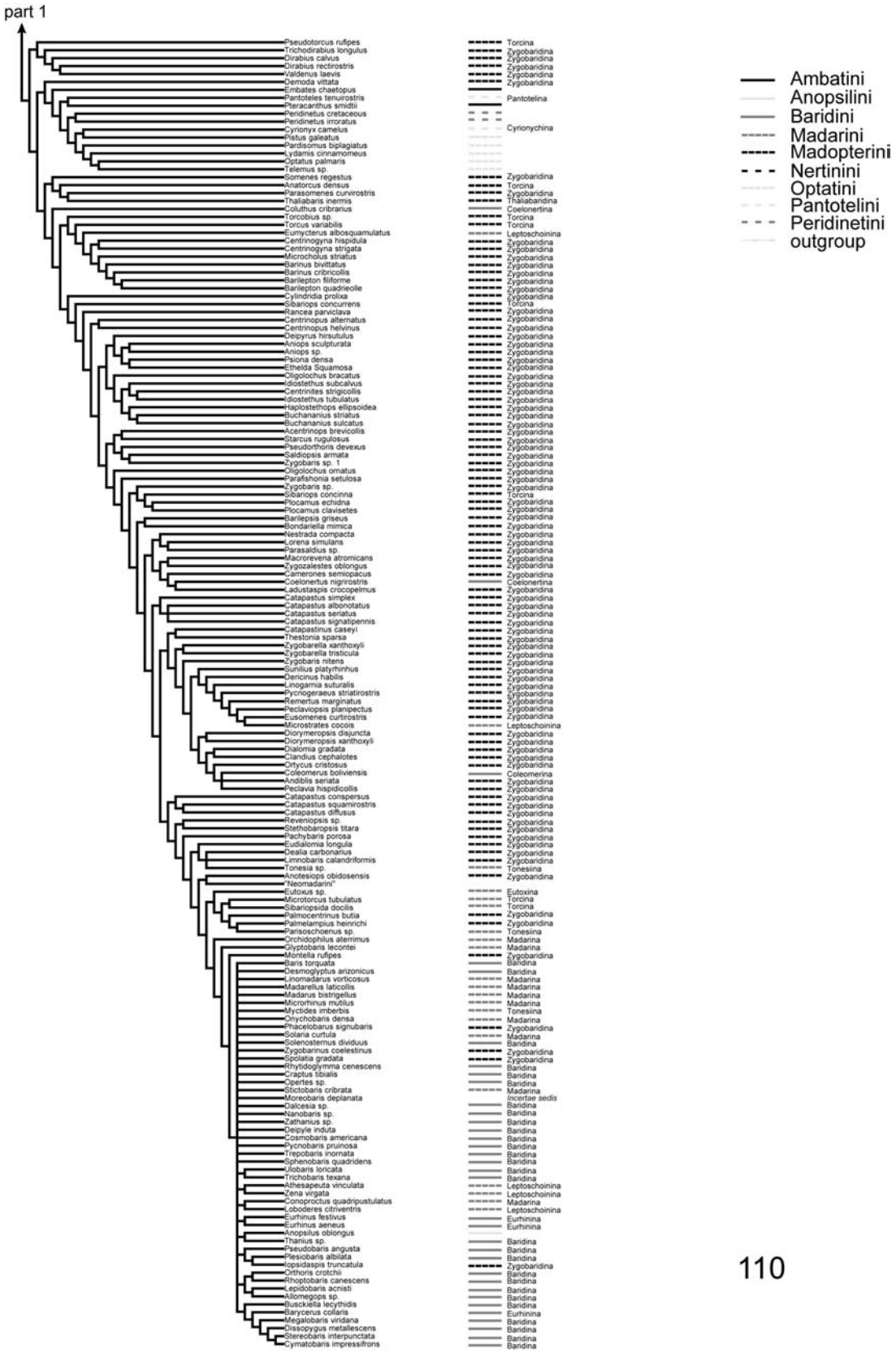
part 1
Pseudotorcus rufipes
Trichodirabius longulus
Dirabius calvus
Dirabius rectirostris
Valdenus laevis
Demoda vittata
Embates chaetopus
Pantoteles tenuirostris
Pteracanthus smidtii
Peridinetus cretaceous
Peridinetus irroratus
Cyrionyx camelus
Platus galeatus
Pardisomus biplagiatus
Lydamis cinnamomeus
Optatus palmaris
Telemus sp.
Somenes regestus
Anatorcus densus
Parasomenes curvirostris
Thaliabaris inermis
Coluthus cribranus
Torcobius sp.
Torcus variabilis
Eumycterus albosquamulatus
Centrinogyna hispidula
Centrinogyna strigata
Microcholus striatus
Barinus bivittatus
Barinus cribricollis
Barilepton filiforme
Barilepton quadrieolle
Cylindridia prolixa
Sibariops concurrens
Rancea parviclava
Centrinopus alternatus
Centrinopus helvinus
Deipyrus hirsutulus
Aniops sculpturata
Aniops sp.
Psiona densa
Ethelda Squamosa
Oligolochus bracatus
Idiostethus subcalvus
Centrinites strigicollis
Idiostethus tubulatus
Haplostethops ellipsoidea
Buchananius striatus
Buchananius sulcatus
Acentrinops brevicollis
Starcus rugulosus
Pseudorthoris devexus
Saldiopsis armata
Zygobaris sp. 1
Oligolochus ornatus
Parafishonia setulosa
Zygobaris sp.
Sibariops concinna
Plocamus echidna
Plocamus clavisetes
Barilepsis griseus
Bondariella mimica
Nestrada compacta
Lorena simulans
Parasaldius sp.
Macrorevena atromicans
Zygozalestes oblongus
Camerones semiopacus
Coelonertus nigrirostris
Ladustaspis croccopelmus
Catapastus simplex
Catapastus albonotatus
Catapastus seriatus
Catapastus signatipennis
Catapastinus caseyi
Thestonia sparsa
Zygobarella xanthoxyli
Zygobarella tristicula
Zygobaris nitens
Surilius platyrhinhus
Dericinus habilis
Linogarnia suturalis
Pycnogeraeus striatirostris
Remertus marginatus
Peclaviopsis planipectus
Eusomenes curtirostris
Microstrates cocois
Diorymeropsis disjuncta
Diorymeropsis xanthoxyli
Dialomia gradata
Clandius cephalotes
Ortycus cristosus
Coleomerus boliviensis
Andibilis seriata
Peclavia hispidicollis
Catapastus conspersus
Catapastus squamirostris
Catapastus diffusus
Reveniopsis sp.
Stethobarogsis titara
Pachybaris porosa
Eudialomia longula
Dealia carbonarius
Limnobaris calandriformis
Tonesia sp.
Anotesiops obidosensis
"Neomadarini"
Eutoxus sp.
Microtorcus tubulatus
Sibariopsida docilis
Palmocentrinus butia
Palmelampius heinrichi
Parisoschoenus sp.
Orchidophilus aterrimus
Glyptobaris lecontei
Montella rufipes
Baris torquata
Desmoglyptus arizonicus
Linomadarus vorticosus
Madarellus laticollis
Madarus bistrigellus
Microrhinus mutilus
Myctides imberbis
Onychobaris densa
Phacelobarus signubaris
Solaria curtula
Solenosternus dividuus
Zygobarinus coelestinus
Spoliatia gradata
Rhytidoglymma cenescens
Craptus tibialis
Opertes sp.
Pictobaris cribrata
Moreobaris deplanata
Oalcesia sp.
Nanobaris sp.
Zathanius sp.
Deipylie induta
Cosmobaris americana
Pycnobaris pruinosa
Trepobaris inornata
Sphenobaris quadridens
Ulobaris loricata
Trichobaris texana
Athesapeuta vinculata
Zena virgata
Conoproctus quadripustulatus
Loboderes citriventris
Eurhinus festivus
Eurhinus aeneus
Anopsilus oblongus
Thanius sp.
Pseudobaris angusta
Plesiobaris albilata
Iopsidaspis truncatula
Orthoris crotchii
Rhoptobaris canescens
Lepidobaris acnisti
Allomegops sp.
Buscklella lecythidis
Barycerus collaris
Megalobaris viridana
Dissopygus metallescens
Stereobaris interpunctata
Cymatobaris impressifrons
Torcina
Zygobaridina
Zygobaridina
Zygobaridina
Zygobaridina
Zygobaridina
Pantotelina
Cyrionychina
Zygobaridina
Torcina
Thaliabaridina
Coelonertina
Torcina
Torcina
Leptoschoinina
Zygobaridina
Zygobaridina
Zygobaridina
Zygobaridina
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Zygobaridina
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According to the current classification of Alonso-Zarazaga and Lyal (1999), a monophyletic Baridinae was not recovered. Falling within various places in the outgroup were the following taxa previously placed within Baridinae: *Calandrinus grandicollis*, *Microcholus puncticollis*, *Oomorphidius leavicollis*, *Eisonyx opaca*, *Eisonyx crassipes*, *Elasmobaris signifer*, *Fishonia brevinasus*, and *Neplaxa illustris*. The sister clade to Baridinae is Orobitidinae, followed by Conoderinae (though Conoderinae is divided in this result), Curculioninae, Molytinae, and Cryptorhynchinae. The position of Conoderinae in the outgroup is uncertain in this study, although this result may also reflect instability in conoderine phylogeny and classification. The sister-group relationships, relative to Baridinae, obtained in this study are similar to those obtained in Marvaldi *et al.*'s (2002) phylogeny of Curculionoidea.

Character tracing and character evolution

Although not displayed, characters 99 and 100 share the same topological distribution, and character 101 is similar in distribution. Based on the results of this study, characters 41, 46, 54, and 98-100 appear to be indicative of a monophyletic Baridinae. Character 88 also is shared by most Baridinae. Because the grouping of taxa in the outgroup that was previously included in Baridinae shares some features with Baridinae (as defined here), such as the developed lobe on the lateral margin of the postnotum, its topological position may change with the inclusion of more taxa and examination of more characters. Although this group does appear to possess

plesiomorphic qualities in comparison to the remainder of Baridinae, it is uncertain whether or not these qualities correctly place them outside of Baridinae due to the combination of high homoplasy and small ratio of characters to taxa.

Character weighting using implied weights

All analyses using implied weights resulted in 1 phylogeny. Phylogenies from analysis of the complete dataset using K=2, 4, 6, and 8 are displayed in Figs. 128-131, respectively. Many of the taxa within the groupings that are defined by the strict consensus tree of the equal weights analysis have moved position in the implied weights analyses. Although the non-baridine taxa largely remain in the outgroup, a few (*Derelomus*, *Balanogastris*, *Telephae*) appear nested within the ingroup.

Phylogenies from analysis of the RTM using K=2, 4, 6, and 8 are displayed in Figs. 132-135, respectively. Similar to the analysis of the full dataset, many taxa within the groupings defined in the strict consensus of the equal weights analysis of the RTM have moved position in the implied weights analyses. Also, the same outgroup taxa (*Derelomus*, *Balanogastris*, *Telephae*) appear nested within the ingroup.

Bayesian analyses

The bayesian phylogeny produced from analysis of the full dataset using 3 million generations (Fig. 136) is much more concordant with the strict consensus tree produced from the parsimony analysis in TNT (Fig. 110) than is the phylogeny

produced from the bayesian analysis with 10 million generations (Fig. 137). As evident from the Tracer plots (and the posterior probabilities on the trees), even though the tree space of the 10 million generation analysis (Figs. 145-149) was better sampled than that of the 3 million generation analysis (Figs. 140-144), the phylogeny of the 10 million generation run is highly incongruent with the parsimony-produced phylogeny.

The bayesian phylogenies produced from analyses of the RTM using 3 (Fig. 138) and 10 million generations (Fig. 139) were both highly concordant with the strict consensus tree produced from the parsimony analysis in TNT (Fig. 116). Also, none of the outgroup taxa in the bayesian phylogenies fell within the ingroup. The posterior probabilities on the bayesian trees from both runs are identical. As visible from the Tracer plots, the tree space of the 10 million generation analysis (Figs. 155-159) was much better sampled than that of the 3 million generation analysis (Figs. 150-154).

Discussion

It is particularly evident that the dataset compiled in this study results in an extremely homoplasious phylogeny, a phenomenon not exceptional of datasets with large numbers of taxa (Sanderson and Donaghue 1989). Very few synapomorphies were hypothesized and even fewer appeared to withstand a phylogenetic test. Many factors are believed to have contributed to this phenomenon. Due to its size, it is doubtful that the dataset is free of errors. Thus it is possible that phylogenetic noise

was introduced through human error. Another contributing factor is homology assessment. Because of the large number of taxa examined, the diversity in morphological shapes and structures made it difficult to define decisive character states. The resulting cladogram reflects this difficulty in forming hypotheses of homology, and the large degree of homoplasy may indicate that many character states that were hypothesized to be homologous actually are not. Due to the excessive amount of homoplasy in the tree, non-homoplasious synapomorphies for the subfamily are unable to be defined, at least from the results of this study. Synapomorphies nonetheless can be defined, though, which are present in the majority of taxa. The lateral margin of the postnotum of the metanotum is developed and projecting (character 54) in most baridines but reduced and smooth in all outgroup taxa (Fig. 123). The posterior margin of the mesonotum (character 46) is most often developed and projecting (with the projecting apex acute or rounded) in Baridinae, while outgroups possess various forms of a reduced margin which does not form a projecting apex (Fig. 122).

Comparison of complete matrix analysis to RTM

As has been shown by numerous studies (Hillis 1998; Graybeal 1998), the addition of more taxa to a phylogenetic analysis may increases topological accuracy. The phylogeny of Baridinae provides no exception. In comparing the tree obtained from analysis of the complete data matrix to the tree obtained from analysis of the RTM, a few major differences are evident; however, despite changing taxon

composition, the topology remained similar. Because of the reduction in the number of taxa included in the RTM, the clades present in this tree are fewer than those present in the complete tree. The majority of clades shared in both the complete tree and RTM tree also have similar topological identity, although a few do not.

This result supports previous conclusions that incomplete taxon sampling may bias phylogenetic studies, in which topology may change through the addition of taxa to the analysis. It also indicates, though, and supports evidence suggesting that taxon composition, despite affecting the number of clades present in a phylogenetic tree, has little effect on overall topology (Miller and Hormiga 2004). Thus, although greater taxon sampling is always desired, and certainly is desired with baridines and weevils in general, more rigorous character examination is needed to help resolve baridine phylogeny. Also, although the complete dataset contained more than fifty taxa with approximately 60% missing data, the inclusion of these taxa appeared not to have affected topological accuracy (in comparing the strict consensus tree to the RTM tree). This result supports previous studies that explained differences in the way missing data and missing taxa affect phylogenetic accuracy (Wiens 1998, 2003a, b). Even though large amounts of missing data per taxon in a matrix may greatly affect topological accuracy and phylogenetic resolution, if these missing data is more evenly distributed throughout the matrix so as not to be particular to a few taxa, then the effect on the resulting phylogeny will not be markedly large.

Implications towards baridine classification

Despite the breadth of this study, in which slightly more than half of the extant, described genera were examined, several observations can be made about the evolution of this diverse group. Although it is a definitive goal to revise the baridine classification system, it is believed that this single study is not rigorous enough to propose and adopt a new system, but can be thought of as a starting point towards elucidating the evolution of this group.

As a result of this study, it is evident that the current classification for Baridinae is inadequate. All of the currently recognized tribes and subtribes are shown to be paraphyletic, and a few, such as Madopterini and Baridini, are polyphyletic, particularly the former. It appears, however, that Optatini may represent a valid tribe, with some minor adjustments to the taxa and characters that define it. Also Baridini, despite being polyphyletic, may also represent a real evolutionary grouping in a narrower sense.

The following is a list of groupings (mostly clades) and characters present at these nodes in the full tree that are suggestive of a revised classification of Baridinae (Fig. 111), though no taxonomic rankings will be proposed for these groups. Although many clades do appear in the strict consensus tree, there are also paraphyletic lineages (groups 2, 6-8, 12-13) that I suggest as possible groupings due to the number of characters they share. The boundaries of these paraphyletic lineages are not delineated randomly, and they share character states that group them together, even though the states may be homoplasious and shared by other groups on the tree. Provided further refinement of characters and more rigorous studies of baridine

phylogeny, these groupings may or may not represent true clades. The characters shared among the indicated paraphyletic groupings also are not only strictly present within those taxa and may be present within adjacent taxa as well. The characters that only provide significant structure to clades (i.e. are possessed by a majority of the taxa) are mentioned below. Although most clades are supported by numerous characters, most of them are homoplasious at lower levels, thus those characters showing the least homoplasy are listed below. Most clades are accounted for; however, a few groupings whose hierarchical rank is dubious are not defined. Character evolution is followed using WinClada's fast optimization.

Group 1 (Baridinae): 41, 46, 48, 54, 98, 99, 100, 101

Group 2: 62, 73, 74, 76

Group 3: 62, 73, 74, 76

Group 4: 20, 21, 50, 55, 63, 74, 90, 91, 95, 104

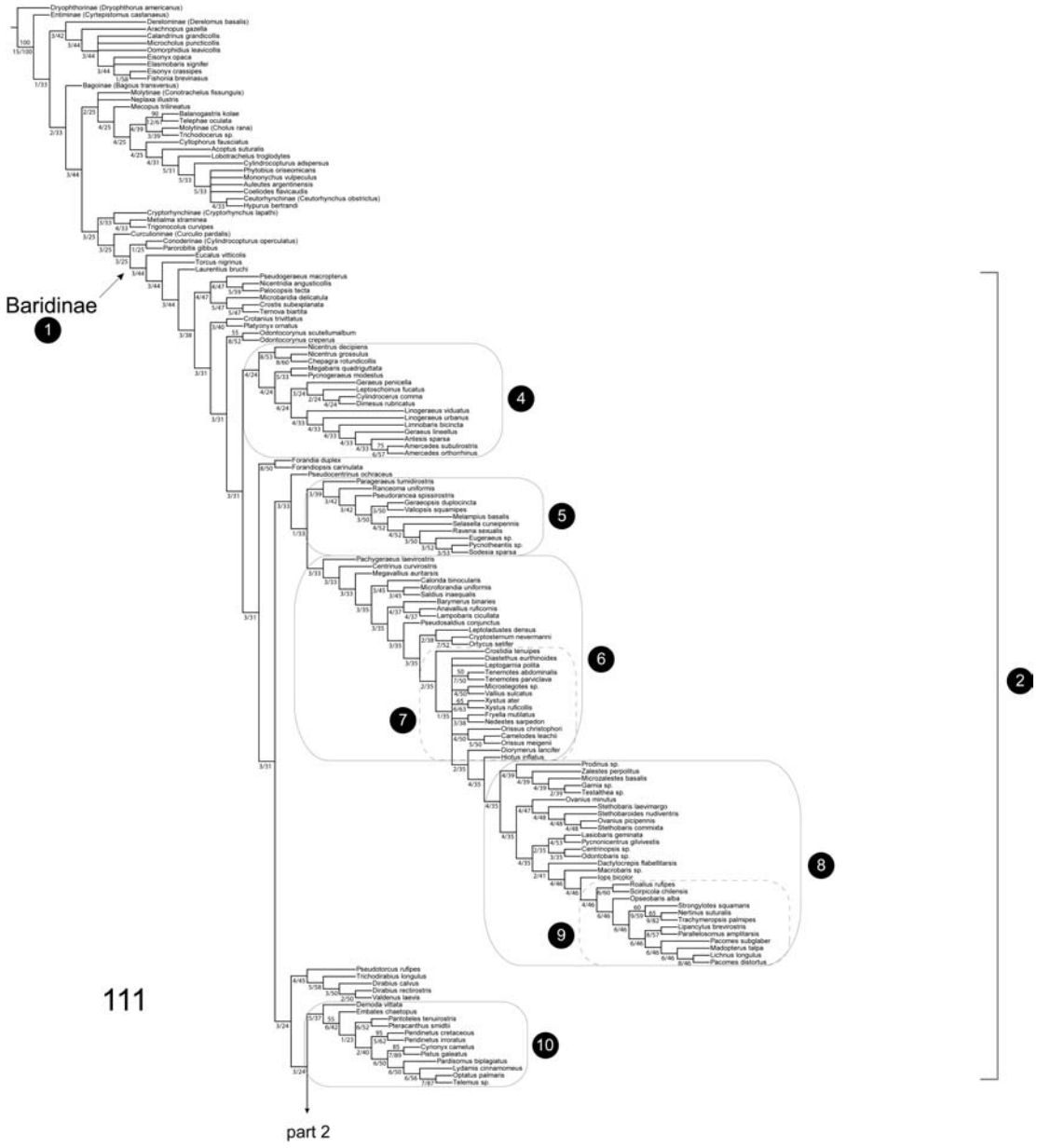
Group 5: 21, 32, 44, 55, 62, 80, 90, 95, 97

Group 6: 21, 44, 70, 71

Group 7 (subclade of 6): 30, 32, 33, 37, 94, 95, 96, 97

Group 8: 10, 17, 19, 21, 44, 55, 71, 97, 103, 108, 109

Group 9 (subclade of 8): 3, 4, 23, 32, 33, 38, 39, 47, 54, 59, 64, 66, 68, 78, 89


Baridinae
1
2
4
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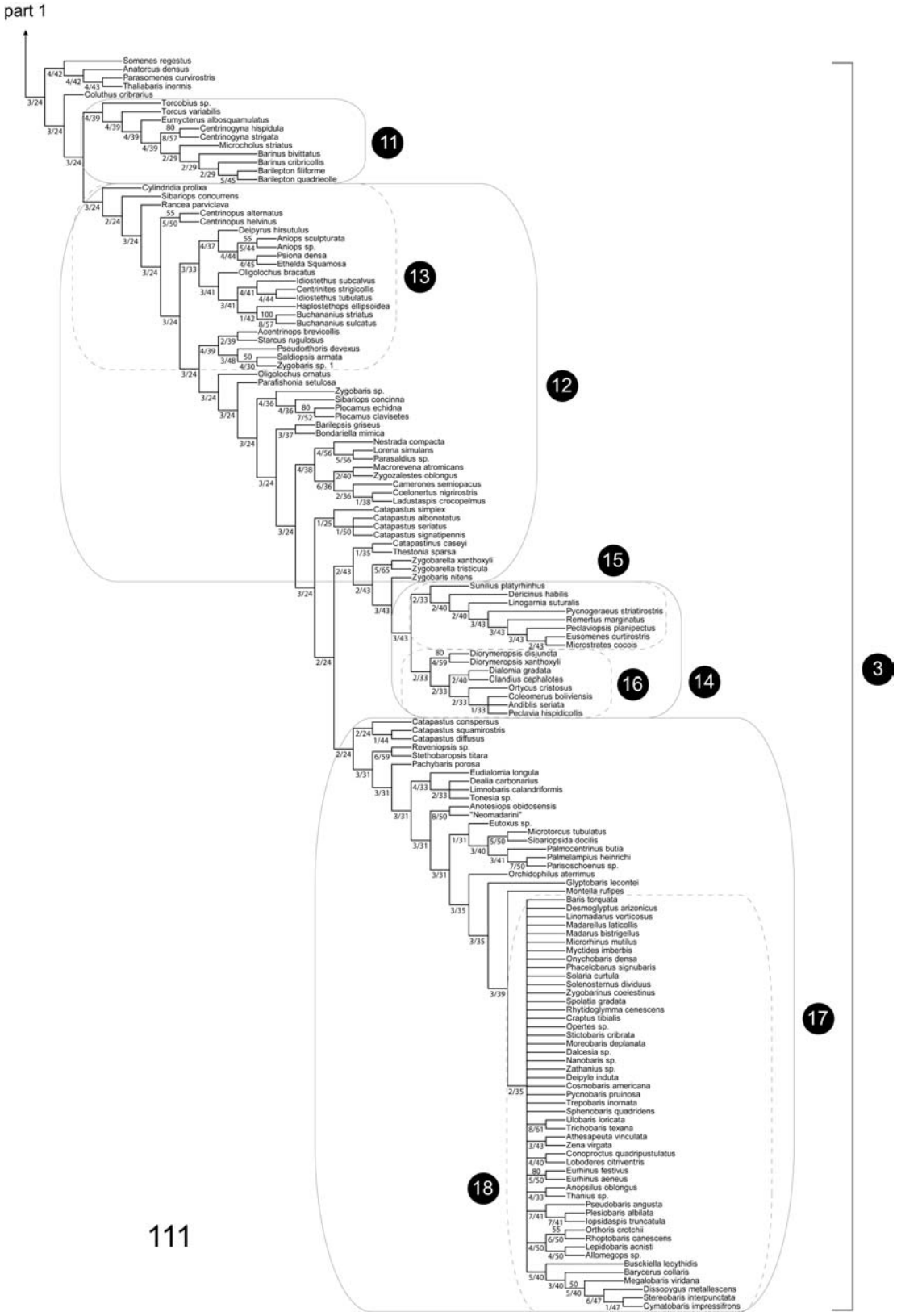
6
7
8
9
10
111
part 2


part 1
Somenes regestus
Anatorcus densus
Parasomenes curvirostris
Thaliabaris inermis
Coluthus cribrarius
Torcobius sp.
Torcus variabilis
Eumycterus albosquamulatus
Centrinogyna hispidula
Centrinogyna strigata
Microcholus striatus
Barinus bivittatus
Barinus cribricollis
Barilepton filiforme
Barilepton quadrieolle
11
Cylindridia prolixa
Sibariops concurrens
Rancea parviclava
Centrinopus alternatus
Centrinopus helvinus
Deipyrus hirsutulus
Aniops sculpturata
Aniops sp.
Psiona densa
Ethelda Squamosa
Oligolochus bracatus
Idiostethus subcalvus
Centrinites strigicollis
Idiostethus tubulatus
Haplostethops ellipsoidea
Buchananius striatus
Buchananius sulcatus
13
Acentrinops brevicollis
Starcus rugulosus
Pseudorthoris devexus
Saldiopsis armata
Zygobaris sp. 1
Oligolochus ornatus
Parafishonia setulosa
Zygobaris sp.
Sibariops concinna
Plocamus echidna
Plocamus clavisetes
Barilepsis griseus
Bondariella mimica
Nestrada compacta
Lorena simulans
Parasaldius sp.
Macrorevena atromicans
Zygozalestes oblongus
Camerones semiopacus
Coelonertus nigrirostris
Ladustaspis crocopelmus
Catapastus simplex
Catapastus albonotatus
Catapastus seriatus
Catapastus signatipennis
Catapastinus caseyi
Thestonia sparsa
12
Zygobarella xanthoxyli
Zygobarella tristicula
Zygobaris nitens
15
Sunilius platyrhinhus
Dericinus habilis
Linogarnia suturalis
Pycnogeraeus striatirostris
Remertus marginatus
Peclaviopsis planipectus
Eusomenes curtirostris
Microstrates cocois
Diorymeropsis disjuncta
Diorymeropsis xanthoxyli
Dialomia gradata
Clandius cephalotes
Ortycus cristosus
Coleomerus boliviensis
Andiblis seriata
Peclavia hispidicollis
16
14
Catapastus conspersus
Catapastus squamirostris
Catapastus diffusus
Reveniopsis sp.
Stethobaropsis litara
Pachybaris porosa
Eudialomia longula
Dealia carbonarius
Limnobaris calandriformis
Tonesia sp.
Anotesiops obidosensis
"Neomadarini"
Eutoxus sp.
Microtorcus tubulatus
Sibariopsida docilis
Palmocentrinus butia
Palmelampius heinrichi
Parisoschoenus sp.
Orchidophilus aterrimus
Glyptobaris lecontei
Montella rufipes
Baris torquata
Desmoglyptus arizonicus
Linomadarus vorticosus
Madarellus laticollis
Madarus bistrigellus
Microrhinus mutilus
Myctides imberbis
Onychobaris densa
Phacelobarus signubaris
Solaria curtula
Solenosternus dividuus
Zygobarinus coelestinus
Spolatia gradata
Rhytidoglymma cenescens
Craptus tibialis
Opertes sp.
Stictobaris cribrata
Moreobaris deplanata
Dalcesia sp.
Nanobaris sp.
Zathanius sp.
Deipyle induta
Cosmobaris americana
Pycnobaris pruinosa
Trepobaris inornata
Sphenobaris quadridens
Ulobaris loricata
Trichobaris texana
Athesapeuta vinculata
Zena virgata
Conoproctus quadripustulatus
Loboderes citriventris
Eurhinus festivus
Eurhinus aeneus
Anopsilus oblongus
Thanius sp.
Pseudobaris angusta
Plesiobaris albilata
Iopsidaspis truncatula
Orthoris crotchi
Rhoptobaris canescens
Lepidobaris acnisti
Allomegops sp.
Buskiella lecythidis
Barycerus collaris
Megalobaris viridana
Dissopygus metallescens
Stereobaris interpunctata
Cymatobaris impressifrons
18
17
3
111

Group 10: 24, 36, 43, 51, 58, 61, 63, 64, 66, 67, 75, 78, 80, 81, 87, 89, 90, 95, 101, 108, 111

Group 11: 3, 10, 20, 58, 59, 63, 81, 88, 109

Group 12: 26, 36

Group 13 (subclade of 12): 70, 102

Group 14: 17, 19, 20, 36, 50, 91

Group 15 (subclade of 14): 33, 34

Group 16 (subclade of 14): 63

Group 17: 3, 20, 34

Group 18 (subclade of 17): 17, 58, 61, 63, 73, 82, 83, 86, 89, 95, 96, 102, 103, 107, 109

Below is a list of groupings (mostly clades) and characters present at these nodes in the RTM tree (Fig. 117). The topology of the RTM tree and the corresponding characters supporting the clades are similar to the full tree, however it is clear that some clades are missing and are different in taxon composition due to the elimination of taxa in the analysis.

Group 1 (Baridinae): 92, 93, 98, 99, 100, 101

Group 2: 62, 72, 73, 74, 75

Group 3: 62, 72, 73, 74, 75

Group 4: 17, 32, 51, 54, 88, 108, 109

Group 5: 19

Group 6 (subclade of 5): 48, 59, 83

Group 7 (subclade of 5): 5, 28, 50, 59, 62

Group 8: 24, 36, 43, 46, 51, 58, 61, 64, 66, 67, 75, 87, 90, 101, 108, 111

Group 9: 36

Group 10 (subclade of 9): 102, 103

Group 11 (subclade of 9): 37, 38, 39, 47, 54, 59, 66, 64, 70, 78, 82, 109

Group 12: 3, 15, 26, 32, 45, 50, 51, 58, 66, 68

Group 13 (subclade of 12): 19, 33, 52, 56, 91

Group 14: 26, 48

Group 15: 112

Group 16: 17, 36, 46, 61, 73, 80, 82, 83, 107, 108

Group 17 (subclade of 16): 3, 10, 51, 56, 86, 91, 94

Group 18 (subclade of 16): 13, 59, 89, 90, 109

Group 19 (subclade of 16): 3, 14, 23, 69, 91

Despite incongruence in results obtained from the implied weights analyses of both full datasets and the RTM, the strict consensus tree (Fig. 111) of the analysis of the full dataset is believed to represent the best hypothesis of baridine evolution to date. Given the data, the RTM analysis derived a strict consensus tree (Fig. 116) with similar topology to that of the full dataset. Regardless of the high amount of homoplasy, several characters support clades and suggested groupings that are present in the analyses of both the full dataset and the RTM. Although jackknife

values and bremer support values are relatively low at many of the major basal nodes, these types of values can be expected from analyses, such as this one, with a low ratio of characters to taxa. It is believed that with the addition of more characters, not only morphological ones, the phylogeny of Baridinae will obtain greater stability.

Biogeography of Baridinae

From examination of mapping the biogeographic zones onto the strict consensus tree (Fig. 126), no specific distribution patterns or patterns of dispersion are visible. Approximately 75% of the known baridine genera are found in the Neotropics. Because relatively few Old World taxa were included in this study, it is difficult to interpret any biogeographic patterns. In order to definitively assess biogeographic patterns within Baridinae, denser sampling is needed of Old World taxa.

Host plant utilization

All known host records were mapped onto the strict consensus tree (Fig. 127); however, because records are available for extremely few baridine genera, no definitive trends in host plant evolution are evident. It is believed that the superfamily Curculionoidea originated sometime during the early to middle Jurassic (Grimaldi and Engel 2005), with the Curculionidae appearing during the middle Cretaceous (Farrell 1998). From Farrell (1998), it can be estimated that along with the other curculionid subfamilies, Baridinae originated sometime during the late

Cretaceous. These origins, outside of Curculionidae, mostly show weevils as feeding on conifers and cycads, subsequently radiating onto angiosperms. Presently, no baridines are known to feed on gymnosperms. Because the subfamily is believed to have radiated long after the origin of angiosperms, it is unlikely that any patterns exist of transitions from monocotyledons to dicotyledons. Thus, a more complex story must exist for explanation of host plant patterns in Baridinae, one that requires much more biological data than is presently available to answer.

Character weighting in baridine phylogenetics

In the implied weights analyses of both full dataset and the RTM, the higher the value of K, the greater stability of the tree topologies. Although the trees analyzed with K=2 were quite different in topology to the strict consensus trees analyzed with equal weights, they were much more similar to the subsequent trees analyzed with K=4, 6, and 8. Aside from the suboptimality of the weighted trees, their topologies are fairly different from the equal weights analyses. Previous studies have reported increased phylogenetic stability by down-weighting homoplasy using implied weights (Goloboff *et al*. 2008). Through analysis of both full datasets and the RTM, this study also appears to corroborate those previous accounts. Stability of clades became more apparent as the value of k was increased. Because of the high amount of homoplasy in the resulting cladograms under equal weights (~97% of all morphological characters are recognized as homoplasious), the accuracy of the phylogenies under implied weights is uncertain. Weighting schemes based on

homoplasy indices are designed to down-weight homoplasious transformations in characters, causing them to contribute less to the topology of the tree (Goloboff 1997); however, situations involving datasets that produce trees with mostly homoplasious characters have not been explored. In accordance with other studies which argue that homoplasy is a natural biological phenomenon, especially as the number of examined taxa increases, that provides definition to phylogenetic structure (Källersjö *et al*. 1999), if these characters are down-weighted during phylogenetic analysis, there potentially might be a large effect on tree topology. Also, due to uncertainty in how much of the homoplasy present in the equal weight trees constitutes false statements of homology and how much actually represents independent character state origins (Farris 1983), it is difficult to assess phylogenetic accuracy of character weighted analyses.

Concordance of bayesian and parsimony analyses

Because of the highly homoplasious baridine phylogeny, another tree-building method beyond parsimony was implemented (bayesian analysis) to assist in elucidating if this high amount of homoplasy is due to evolutionary history or is a random artifact. These analyses were also conducted to examine the effects of using highly homoplasious data under a bayesian framework.

The results produced from both analyses of the full dataset are rather inconclusive in reference to baridine phylogeny. While it is interesting to note that the bayesian tree produced from the run with 3 million generations is more

concordant with the strict consensus tree produced by parsimony using TNT than is the tree produced from the run with 10 million generations, both of the bayesian-produced trees are still quite incongruent with the parsimony-produced tree. Although the log likelihoods show more of an asymptotic behavior as the number of generations increased from 3 to 10 million, and the sampled distribution of tree lengths is more normally distributed, the topology appears to have become less congruent with increased generation time.

The results from bayesian analyses of the RTM, on the other hand, are much more topologically similar to the respective parsimony analyses of the RTM. Taxa within the major groupings (defined in Fig. 117) change position between the bayesian runs; however, the groupings remain static and largely concordant with the parsimony-produced tree. These results are quite different from the parsimony analyses, in which both the analysis of the full dataset and of the RTM are topologically congruent.

Final thoughts and future directions in baridine phylogenetics

Indeed, a high amount of homoplasy in phylogenies with large numbers of taxa which are produced from morphological data can be expected and may not be cause for much concern. Because homology is a *post hoc* assessment, those characters which turn out not to be homologous on a phylogeny are homoplasies (Wake 1999). Thus, homoplasies not only give structure to trees as synapomorphies do, they also delineate which characters do not have the same qualities. However, if

homoplasy can be equated to noise (structure created from random data by chance; Wenzel and Siddall 1999), then it is uncertain how much of the homoplasy in the baridine dataset represents noise. If phylogenetic structure is attributed to randomness in the characters then there is no reason why the most-parsimonious tree should be selected as that providing the best hypothesis for evolution within any particular groups (Hillis and Huelsenbeck 1992). Thus, separating the amount of homoplasy that is due to noise and that which is caused by evolutionary history is integral in examining and improving large phylogenetic studies such as this one.

In order to discriminate between phylogenetic signal and noise, and to further assess the quality of the data, future work on baridine phylogenetics may include examination of the distributions of tree-length skewness (Huelsenbeck 1991). Given the results from analyses of the full dataset and RTM, the data appears to be consistent (Hillis 1995), in that addition of more data from the RTM to the full dataset resulted in similar phylogenies. Moreover, convergent results from the bayesian analyses of the RTM datasets illustrate robustness of the data.

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Appendix I. Character matrix - characters 0 – 36. * = [0,4]; $ = [0,1]

```
                                          0    5    10   15   20   25   30   35
                                          |    |    |    |    |    |    |    |
Dryophthorinae (Dryophthorus americanus)  00100001010240101421020100110000011110
Bagoinae (Bagous transversus)             00101002011002012311020140110020000110
Conoderinae (Cylindrocopturus operculatus) 00101002110012010221120120011020200110
Conoderinae (Trichodocerus sp.)           00101001100003013301200100211020000110
Conoderinae (Arachnopus gazella)          01121002112002010100311100110020010010
Conoderinae (Cyllophorus fausciatus)      10011002112002000100210110111010010110
Conoderinae (Metialma straminea)          10101002112002110301210110010020111110
Conoderinae (Balanogastris kolae)         10101002112002010311200110010020110116
Conoderinae (Telephae oculata)            10101002111002012301200110211020100106
Conoderinae (Cylindrocopturus adspersus)  00101002110002000211300120110020000110
Conoderinae (Acoptus suturalis)           00101002112000100001001120111020000116
Conoderinae (Lobotrachelus troglodytes)   10101002111002010311100120110020100111
Conoderinae (Mecopus trilineatus)         00121102111002002201111110100020011110
Ceutorhynchinae (Ceutorhynchus obstrictus) 10101002110012010311302130110020100110
Ceutorhynchinae (Hypurus bertrandi)       10101002111002000311300130110020000116
Ceutorhynchinae (Phytobius oriseomicans)  10101002112002000311300130110020011116
Ceutorhynchinae (Mononychus vulpeculus)   10101002112000000311300130210020100116
Ceutorhynchinae (Auleutes argentinensis)  10101002111000000311300130110020100116
Ceutorhynchinae (Coeliodes flavicaudis)   10101002111002000311300130110020000116
Curculioninae (Curculio pardalis)         00101001110002013100102140010020011110
Molytinae (Cholus rana)                   10101102111002010311120040110200001 10
Molytinae (Trigonocolus curvipes)         10001002111001212311202130010001 22116
Molytinae (Conotrachelus fissunguis)      00101002111002012000200100110020011 1*
Entiminae (Cyrtepistomus castanaeus)      00101001031001011601122110010020011 10
Derelominae (Derelomus basalis)           01100002111002112221020140010000111 10
Cryptorhynchinae (Cryptorhynchus lapathi) 00101002111002010321200100211020101 00
Orobitidinae (Parorobitis gibbus)         10001102110012012??????10011002020116
Acentrinops brevicollis                   10111102112002010201200000211010101 04
```

Amercedes subulirostris	10101100110002010200020000021002020104
Amercedes orthorrhinus	10111100110002010200020000021002020114
Anavallius ruficornis	10111100112002002200000010010001011000
Anopsilus oblongus	00110002112002100221000101110000010102
Antesis sparsa	00111102111002110200310000021102020114
Athesapeuta vinculata	00111102111002100201210100111101001013
Barilepsis griseus	00101102112002100301200100111102001111
Barilepton filiforme	00111002021002100301300100011002002013
Barilepton quadrieolle	00111002121002000301000100011102002113
Barinus bivittatus	00121002011002000201300000111101000114
Barinus cribricollis	00101102121002010301200100111101000113
Baris torquata	00101102111002110311100000011001$11113
Barymerus binaries	01101000110000002000300100111101011012
Buchananius striatus	10101002111002010311020100211102010111
Buchananius sulcatus	10101002111002110311320100211102110111
Busckiella lecythidis	10100002012000200221210000111100112114
Calandrinus grandicollis	00121002112002010201310000211102001114
Camelodes leachii	10100002112002110200210000201100200103
Catapastinus caseyi	10111102112002110301200100211102011004
Catapastus conspersus	10101102112002010301200100211102011014
Catapastus squamirostris	10111102111002110301200100211102011014
Catapastus albonotatus	10101102112002110301200100211102021011
Catapastus diffusus	10111102112002110?????0100211102021014
Catapastus seriatus	10101102112002110301000100211002021011
Catapastus signatipennis	10101102112002210301220100211002021011
Catapastus simplex	1010110211200201?????0100211002011011
Centrinites strigicollis	00101102111000112301210100211002110114
Centrinogyna hispidula	00121102111002110301210100211102101114
Centrinogyna strigata	00121102111002110321210100211101101114
Centrinopsis sp.	10100002111002100221100000111000011013
Centrinopus alternatus	00111002112000100301200100240020111104
Centrinopus helvinus	00101002112000100301100000221020111101
Centrinus curvirostris	10101002112002012200210100201020211105
Coelonertus nigrirostris	00101002112000100201200100211002010104
Coleomerus boliviensis	10111002110000100000000100111101010102
Conoproctus quadripustulatus	00110012111001012200100140111000011114
Crostidia tenuipes	1010010211200101?????0140210000210000
Crotanius trivittatus	00101102111002012?????0140230020101114
Cylindridia prolixa	00101002112002010201010000130010011114
Cylindrocerus comma	00101002111001212000000140100000021114
Cyrionyx camelus	10101002112002010301000140211120110014
Dactylocrepis flabellitarsis	00100002111002112?????0140130000101003
Dealia carbonarius	00121102112002112?????0000110000001011
Deipyrus hirsutulus	00101102112000200301100100211002011014
Demoda vittata	01101101112001010201200100121020111114
Desmoglyptus arizonicus	00100102111002100201020100211000020111
Dialomia gradata	10111102112002100?????0100240010101003
Diastethus eurthinoides	10101002120002000000110000110100111110
Dimesus rubricatus	00101102112001110000000100140000111114
Diorymeropsis disjuncta	10111102112002110200300100211010101111
Diorymeropsis xanthoxyli	10111102112002110200000100211010101111
Diorymerus lancifer	10000002110001210?????0100040000201100
Dirabius calvus	00121002111002110201210000111000000114
Dirabius rectirostris	00111002112002110201300000111101002114
Dissopygus metallescens	10120002011000200211000000111010210012
Eisonyx crassipes	00101101011002202221110100211010001113
Eisonyx opaca	00100102111000200311020100111000010100
Elasmobaris signifer	00101102011000200?????0100111020001140
Embates chaetopus	00101002110001010201100040110021110014
Eugeraeus sp.	00121002110002000000110101200021210003
Eumycterus albosquamulatus	00121001112002110201320000111010011111
Eurhinus festivus	10010002111002212201120001110000101130
Eurhinus aeneus	1001000211100221020112000111100010111
Eusomenes curtirostris	11111102011000200?????0100110010010140
Eutoxus sp.	00120102112002010201200100140000211130
Fishonia brevinasus	0110110002200220?????0100111010001111
Fryella mutilatus	11100102012002212?????0000110000110110

Garnia sp.	10110102110001010201100100110000020111
Geraeopsis duplocincta	00101102111002110?????010021001010112
Geraeus lineellus	00111102111002012000000014013102021111
Geraeus penicella	10111100110002010000000010021002011004
Glyptobaris lecontei	10111100112000100200300100211001110010
Haplostethops ellipsoidea	00111002111002110301200100211010010114
Idiostethus subcalvus	10101102111000000301000100211002110114
Idiostethus tubulatus	10101102111000010301210100211011010114
Iops bicolor	01101001111000100?????0140110010011110
Ladustaspis crocopelmus	00101002122002102?????010021002021004
Lampobaris cicullata	10110101121002102301200000100000011014
Lasiobaris geminata	00101102122002210301200100111020010013
Laurentius bruchi	00101002111002010?????010011001000114
Lepidobaris acnisti	00101102111002110221000000110020110011
Leptoschoinus fucatus	10111002112001010000200100110020111114
Lichnus longulus	00120102122000100201300140110000001110
Limnobaris bicincta	00111102111002000300000100111010111111
Limnobaris calandriformis	01120102112002212301000100130000111111
Linogeraeus urbanus	10111102112002010000000000110020111111
Linogeraeus viduatus	10111002112002002100200000130020101113
Linomadarus vorticosus	00111000112002110221000101210010111013
Lipancylus brevirostris	00121001101000100201300040110010011112
Loboderes citriventris	00111102111001110101100100111000111112
Lorena simulans	10121102111000102?????010024102011001
Lydamis cinnamomeus	10101002112002010201100140111020210010
Macrobaris sp.	00100002121002100301100100110000000110
Macrorevena atromicans	10100100112000102?????010021000022114
Madarellus laticollis	10110002112002210200320101110100011013
Madarus bistrigellus	00121002112002110200320101210000011011
Madopterus talpa	00110002111000200201100000111000011115
Megabaris quadriguttata	10101002112001110200300000111020210012
Megavallius auritarsis	10101102112002002201210100110000011114
Melampius basalis	10111102110002110000210100241000201111
Microbaridia delicatula	00101102110002010?????0140110020110004
Microcholus puncticollis	00121002111000000301300000111020010011
Microcholus striatus	00121002111000000?????000021100011114
Microforandia uniformis	11101002112000000?????000011002011013
Microrhinus mutilus	10111010201000020222132010001100010110
Microstegotes sp.	10100002112001212201210100110100010110
Microstrates cocois	00101101112000100?????0100110010010012
Myctides imberbis	10111012111000202211210040111000111110
Nertinus suturalis	00111001102002012000110140110010011115
Nestrada compacta	10111102112002102?????0100230021110002
Nicentrus decipiens	00101002122002000200?0100110020111114
Nicentrus grossulus	00121002121002000200000100111020101114
Odontobaris sp.	11100002101002000211?0100110010111114
Odontocorynus scutellumalbum	00101002111002100200300000111020210012
Odontocorynus creperus	00101002111000100200300000211020110002
Oligolochus bracatus	10101102112000100301200100211010011115
Oligolochus ornatus	00101102112000100301200100211020211113
Onychobaris densa	10111021120001002210201001100001011011
Oomorphidius leavicollis	00120002111000000301200100110000000111
Opseobaris alba	00121102111000100301210100111010011114
Optatus palmaris	10101002112001012201300040211020100100
Orchidophilus aterrimus	00121102111000100301210100111020111113
Orissus meigenii	10100002112002112?????0000200100200113
Orissus christophori	10010002112002112200310000100000020110
Orthoris crotchii	00101101111002110221100100110020211110
Ortycus cristosus	10101102112002?????????0101111121101113
Ovanius picipennis	11100102111002112301100100110000010111
Ovanius minutus	10111021120022103202001001100000010113
Pachybaris porosa	10111002110002102200300100110000021011
Pachygeraeus laevirostris	00101102112002100100110000200020011113
Pacomes subglaber	00121001112002002?????0000110000001110
Palmelampius heinrichi	00111100110000000301000000220010210111
Pantoteles tenuirostris	00101001102002012?????0040110020001110
Parageraeus tumidirostris	00101102111002012000210140131000111115

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Parallelosomus amplitarsis                0112100110100010020120000001001001110
Parasaldius sp.                           1010110211100200230020000023102011101
Parasomenes curvirostris                  0111100211100000220130010011101001113
Pardisomus biplagiatus                    1010100211100001021110014011001011110
Parisoschoenus sp.                        1011110211200200230101000010101021114
Peclaviopsis planipectus                  1010110211200010?????0100111101021014
Peridinetus cretaceous                    0010100211200201221102004011102010110
Peridinetus irroratus                     0010100211200201221102004011102010100
Phacelobarus signubaris                   1010110112100221021130010021112011013
Pistus galeatus                           1010100211200200032131014021112010100
Platyonyx ornatus                         1011110211100101020000010021001021113
Plesiobaris albilata                      0010110212200010031132010011102001010
Plocamus echidna                          0010100011000200022102010011002021111
Plocamus clavisetes                       0010100011000200022100010011002021111
Prodinus sp.                              1001010211100211030132010011000010113
Pseudobaris angusta                       0011010211200210030112010011000010113
Pseudocentrinus ochraceus                 0010100211200201020020010021102010104
Pseudogeraeus macropterus                 0010110211100000230000010021102111014
Pseudorthoris devexus                     0010110211000211030100000011102011014
Pseudotorcus rufipes                      0110100111100210020121010012102001113
Psiona densa                              0010100211100220?????0100110021010014
Pteracanthus smidtii                      0010100111100201021120004021112011010
Pycnogeraeus modestus                     1010100212200201010001000011102021011
Pycnogeraeus striatirostris               1011110211200210010000010021102121013
Pycnonicentrus gilvivestis                1010110211100211?????0140110020110002
Pycnotheantis sp.                         1010010211000000230110010011001021113
Ranceoma uniformis                        0010110111100200?????0140111000201l2
Remertus marginatus                       1010100210000010000????000011101021113
Ravena sexualis                           1011100211000201?????0100210000011001
Reveniopsis sp.                           1011010012000221?????0100110000011011
Rhoptobaris canescens                     0010110211100111022110010011002011014
Saldiopsis armata                         1011110012200211?????0100211021210004
Saldius inaequalis                        1010110211200200?????0100111020210l4
Selasella cuneipennis                     1011110211000201?????0101211000210001
Sibariops concinna                        0011110211200000220100010011002011113
Sibariops concurrens                      0010100111200200020101010011101011111
Solaria curtula                           1011010011000211022100010111100011011
Solenosternus dividuus                    0011010211200010031132000011000011012
Somenes regestus                          0010110211100200?????0000102021114
Stereobaris interpunctata                 1010010211200020022111010021101021112
Stethobaris commixta                      1011010211200121030110010011100010111
Stethobaris laevimargo                    1010000211200210030l2?0100110000l0011
Stethobaroides nudiventris                1011000211000211030120000011100010011
Stethobaropsis titara                     1011010212000221?????000110000l2013
Strongylotes squamans                     0010100110200200010030004011102001013
Telemus sp.                               1010100211000201031110004021112010110
Tenemotes abdominalis                     1011000011000010020121010011000010110
Tenemotes parviclava                      1010100211200010020020?0100110010201l4
Thaliabaris inermis                       0110100211100000?????0000111010011l4
Torcobius sp.                             0012100111100211022131000111101010113
Torcus nigrinus                           0111100210100201030030010011002001114
Torcus variabilis                         0110100111100011020130000012101011114
Trachymeropsis palmipes                   0011100110200211000010004011101002113
Trichodirabius longulus                   0011100211200211220121000011102010114
Valdenus laevis                           0011100211200221?????0000110000000114
Valiopsis squamipes                       0010110011100201020030100210010201l01
Vallius sulcatus                          1010000211200221?????0100210100101l00
Xystus ater                               1010000211000201020000014010000010114
Xystus ruficollis                         1010000211000201020000000011000020114
Zena virgata                              0010110211100010022121010011101011113
Zygobarella xanthoxyli                    1011110211200211030100010021102021014
Zygobarella tristicula                    1011110211200211030100010021002021014
Zygobarinus coelestinus                   0010010211100010?????0000110000110ll
Zygobaris sp. 1                           1011110211200201030100010021102021004
Zygobaris nitens                          1011110211200121030130000021002021011
Zygobaris sp.                             0010100211200210030100010011002011013
Zygozalestes oblongus                     1010110011100020?????0100210000210l4
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Anatorcus densus	01101102111002200??????10011102001114
Andiblis seriata	11101000110002110??????10011002010112
Aniops sculpturata	00101002011000200??????10011002001014
Anotesiops obidosensis	00111102111002100??????10011101001013
Calorida binocularis	10101102112002000??????10011102011002
Camerones semiopacus	00121002112001102??????10121002021011
Chepagra rotundicollis	00121002122002??00??????10111101021014
Clandius cephalotes	10111002112002110??????10121001010113
Crostis subexplanata	00100102121002212??????10011000011000
Dericinus habilis	10111102112002100??????10021101021001
Ethelda Squamosa	00101002121000100??????10021102011012
Eudialomia longula	00111102110002102??????00011001021011
Forandia duplex	00101001112002010??????10011102011014
Forandiopsis carinulata	00101002112002010??????10011102011014
Iopsidaspis truncatula	00110102122002000?0?????10011100001010
Leptogarnia polita	10110102112002110?0?????10111000021013
Leptoladustes densus	10101102112002010??????10020102021113
Linogarnia suturalis	10011102112002102?0?????10021001021003
Microtorcus tubulatus	00111102111002110?0?????10011101001014
Microzalestes basalis	11010100120002000??????10111000020111
Nedestes sarpedon	10100102110001012??????00022000021010
Neplaxa illustris	10100002011002013??????00001000001110
Nicentridia angusticollis	00101102111000000??????10011002011001
Palocopsis tecta	00111102111000000??????10011002011014
Parafishonia setulosa	01101102112000102??????10021101011013
Peclavia hispidicollis	10111000112002010??????10011102010112
Pseudorancea spissirostris	00111102121002212??????10014100000115
Pseudosaldius conjunctus	10101102122002002??????10015102021110
Rancea parviclava	00101000112000100??????00011101010114
Roalius rufipes	00101002112000?00???????10?11102000114
Sibariopsida docilis	00101102111002110?0?????10011101001014
Sodesia sparsa	11111102110000000??????00011002021013
Spolatia gradata	10110102122000200??????10111000011011
Starcus rugulosus	01101002112001?10???????10?21102010114
Sunilius platyrhinhus	11111100110002100??????10121101021003
Ternova biartita	00101102122002012??????10011000011004
Thestonia sparsa	11111102111002110??????10011102011011
Zalestes perpolitus	10010102110002110??????00121000010101
Cymatobaris impressifrons	00101102012000200311200101211011011113
Pacomes distortus	00100102111002002101200100110000001110
Megalobaris viridana	10101002112002200301200000210010221l2
Rhytidoglymma cenescens	00100102112002110311300000111100l2011
Craptus tibialis	00100102112002110201300100210000010101
Testalthea sp.	10000002110001210311300100111000201l0
Barycerus collaris	10120002012000200201100000110000l2011
Opertes sp.	10111002111002100200300100211000l0111
Stictobaris cribrata	00101102121000200201300100211020l1010
Moreobaris deplanata	00100102112000100201200100211000210l3
Ulobaris loricata	00101002112000200311210100211000010l0
"Neomadarini"	00111102111002110301300100111000211l3
Trichobaris texana	00101102122000200311200100211020210l3
Dalcesia sp.	00100002112002110311300000110000001l1
Nanobaris sp.	11101102111000100211300100110020001l0
Zathanius sp.	10111102122002110201200100211020010l1
Allomegops sp.	10101002111002110201200001210020001l3
Deipyle induta	10111002112002210201320100111020110l1
Cosmobaris americana	00101102121000000311200100210020110l3
Thanius sp.	00110002112002110301300100121100010102
Cryptosternum nevermanni	10101002112002110?????000021102002011
Pycnobaris pruinosa	10111102122000200201110100211020220l1
Tonesia sp.	11120102112002110301300100210000010l1
Trepobaris inornata	00110102122000200201300100210000001l1
Hiotus inflatus	10010002122002110100200100110000201l0
Sphenobaris quadridens	11111102112002110201300101110021120l1
Coluthus cribrarius	00101002111002010201300100211020l0103
Aniops sp.	00101002111000200301200100210020110l4
Montella rufipes	10111102112000210??????10011100022010

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Palmocentrinus butia                        00111002110002110??????10013101021012
Bondariella mimica                          00101100110002100??????10021102001011
Eucalus vitticolis                          00101002111002010??????10021002001010
Scirpicola chilensis                        00101002111002010??????10011102001110
Ortycus setifer                             10111002112002012100210100211021220l0
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Appendix I (continued). Character matrix - characters 37 – 73

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                                            37   42   47   52   57   62   67   72
                                            |    |    |    |    |    |    |    |
Dryophthorinae (Dryophthorus americanus)    01000023122110002102122012010111232l3
Bagoinae (Bagous transversus)               30100023120110102103120000110111230l1
Conoderinae (Cylindrocopturus operculatus)  01110020121110022103010002101111221l0
Conoderinae (Trichodocerus sp.)             31000140220110022102020010110401102l1
Conoderinae (Arachnopus gazella)            12100021122130010102120110010401313l2
Conoderinae (Cyllophorus fausciatus)        01000024010110142103000000110401601l0
Conoderinae (Metialma straminea)            31101020020110132103020000210101221l0
Conoderinae (Balanogastris kolae)           01001143120110122103020000010401601l0
Conoderinae (Telephae oculata)              01001140120110122103020000020040130110
Conoderinae (Cylindrocopturus adspersus)    11101023120110042103020002100411102l1
Conoderinae (Acoptus suturalis)             01000020220110122103020000100411101l0
Conoderinae (Lobotrachelus troglodytes)     12100020120110012103020001100401622l0
Conoderinae (Mecopus trilineatus)           01200025220100102100112000210401601l0
Ceutorhynchinae (Ceutorhynchus obstrictus)  01011023021000022103010001100111220l0
Ceutorhynchinae (Hypurus bertrandi)         01001020121130002103020002100401200l1
Ceutorhynchinae (Phytobius oriseomicans)    01001023021110042103020000110111202l0
Ceutorhynchinae (Mononychus vulpeculus)     11111023021110042103020002110211212l0
Ceutorhynchinae (Auleutes argentinensis)    11011023021130042103020001100311421l0
Ceutorhynchinae (Coeliodes flavicaudis)     11011023021130042103020000110301222l0
Curculioninae (Curculio pardalis)           00000020121100022103010010210101422l0
Molytinae (Cholus rana)                     00000103122110012102020010210001210l0
Molytinae (Trigonocolus curvipes)           01000020330120311113110001001101321l0
Molytinae (Conotrachelus fissunguis)        01000023120000000000000021010132210
Entiminae (Cyrtepistomus castanaeus)        30200020122110102102122000010101422l1
Derelominae (Derelomus basalis)             31200020222110102102022000010111423l2
Cryptorhynchinae (Cryptorhynchus lapathi)   11000101020110102113110010210121322l0
Orobitidinae (Parorobitis gibbus)           11001020110230010102010010110311222l0
Acentrinops brevicollis                     02101104110111110011000001200111200l1
Amercedes subulirostris                     02101102010011200011000001100010220l1
Amercedes orthorrhinus                      02001100010011200011000001100010420l1
Anavallius ruficornis                       02001104201111200002000101000110202l0
Anopsilus oblongus                          22101100200000210000021012100110201l0
Antesis sparsa                              12101104000001111000000001000111220l1
Athesapeuta vinculata                       11001105210010100000101012100111210l0
Barilepsis griseus                          12101101110010110011010002100111220l1
Barilepton filiforme                        00201100110110200101012000100211223l2
Barilepton quadrieolle                      01001100210110200111012000200211210l1
Barinus bivittatus                          01201100111110110102111101100011210l1
Barinus cribricollis                        01101105210110112101002000100011220l0
Baris torquata                              02101105210000212012021112100011221l0
Barymerus binaries                          12001104201010100002011000210111201l0
Buchananius striatus                        02101112101110102110120002100111200l0
Buchananius sulcatus                        02101112101110102110120002100111200l0
Busckiella lecythidis                       22101105201010101012110012100011321l0
Calandrinus grandicollis                    12101100410l?00?110?1??112001111203l2
Camelodes leachii                           12101102010112100011110100010001211l0
Catapastinus caseyi                         02101100210010210012000102100010222l1
Catapastus conspersus                       02101100210010100002010002200010201??3
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Catapastus squamirostris	021011000100112100020010022000102000 1
Catapastus albonotatus	021011000100101000120100021000102 2???
Catapastus diffusus	021011000100112100020010022??01022???
Catapastus seriatus	021011000100101000120100021000102 2001
Catapastus signatipennis	021011000100101000120100021000102 2001
Catapastus simplex	021011000100101000120100021??01020???
Centrinites strigicollis	020011041101101000120001010001112021 1
Centrinogyna hispidula	010011042101301101000200001001112200 0
Centrinogyna strigata	010011041???101100000101001101112000 1
Centrinopsis sp.	010011102001101020121120102001212011 0
Centrinopus alternatus	021011042111101110011001022001112200 1
Centrinopus helvinus	010011022101101100011001022001112200 1
Centrinus curvirostris	120011021101121100010000012001112211 0
Coelonertus nigrirostris	110011001100101110000110012101102200 1
Coleomerus boliviensis	121011002100121110110001022001102220 1
Conoproctus quadripustulatus	120011020010102120000211111001112110 0
Crostidia tenuipes	021011052??????????????????????11120???
Crotanius trivittatus	020011152101111110000011020000112221 0
Cylindridia prolixa	021011012000101000010220001101112200 1
Cylindrocerus comma	120011041100011120120000001101112211 0
Cyrionyx camelus	021011134000001020110100102101022211
Dactylocrepis flabellitarsis	012011004??????????????????????11020???
Dealia carbonarius	220011052??????????????????????11100???
Deipyrus hirsutulus	021011021101101100001100012001112020 1
Demoda vittata	010011002101102100111120022001112211 0
Desmoglyptus arizonicus	010011001000101100120220121001113220 1
Dialomia gradata	021011000??????????????????????11022???
Diastethus eurthinoides	121011054100121010011001001100010111 0
Dimesus rubricatus	021011122100112000020000012101112221 1
Diorymeropsis disjuncta	120011001100112020010001022001102000 1
Diorymeropsis xanthoxyli	121011001100112020010101022001102010 0
Diorymerus lancifer	121011052101101100121110000100102111 0
Dirabius calvus	010011042100102000110010012001112111 0
Dirabius rectirostris	010011012101102100010110002001112211 0
Dissopygus metallescens	011011011100102020000100122001102211 0
Eisonyx crassipes	021011031111100001001201121002102032 2
Eisonyx opaca	021011031011101121020201121102102032 2
Elasmobaris signifer	021011010??????????????????0011130???
Embates chaetopus	010011002001102000120120000101012211 0
Eugeraeus sp.	221011052101002110110100011001012210 0
Eumycterus albosquamulatus	112011051001101101020220101001112000 1
Eurhinus festivus	010011004000001000120101121000113110 0
Eurhinus aeneus	221011034000111110120200121000103120 0
Eusomenes curtirostris	020011002??????????????????????11141???
Eutoxus sp.	221011001100102120000120021001112210 0
Fishonia brevinasus	211011041??????????????????????11020???
Fryella mutilatus	121011034??????????????????????01041???
Garnia sp.	220011001101121120120100000100102211 0
Geraeopsis duplocincta	021011042??????????????????????11022???
Geraeus lineellus	020011000100111000100000011001112200 1
Geraeus penicella	120011050100111110110000000001110211 0
Glyptobaris lecontei	220011001000001100101200121001112020 0
Haplostethops ellipsoidea	020011012001101120120000021001112100 1
Idiostethus subcalvus	021011041101101020020100022001112001 1
Idiostethus tubulatus	020011044101101000010000????0011120211
Iops bicolor	112011001??????????????????1001022???
Ladustaspis crocopelmus	012011042??????????????????0011022???
Lampobaris cicullata	021011042011101021001200001001112021 0
Lasiobaris geminata	021011011100111120110000012001100221 0
Laurentius bruchi	020011052??????????????????????11100???
Lepidobaris acnisti	121011052011101100001121121001102020 0
Leptoschoinus fucatus	120011040100122110110000000101110201 0
Lichnus longulus	002011011111020101010020002100112221 0
Limnobaris bicincta	021011002100101110100020011001112221 0
Limnobaris calandriformis	220011041100102110120000011001112010 1
Linogeraeus urbanus	221011022100111100120000010001112221 0
Linogeraeus viduatus	021011042100111000100101010001112110 0

Linomadarus vorticosus	2210110200001011000212201210011022100
Lipancylus brevirostris	0020110121110011210111201001001121210
Lobodores citriventris	1200110340011021201211200210011020100
Lorena simulans	0200110521111111111111111111111022???
Lydamis cinnamomeus	0110111520011021111011011001010121110
Macrobaris sp.	0020111111111000201200200021001022210
Macrorevena atromicans	0100110521111111111111111111111002???
Madarellus laticollis	2210110320000021100012011210010022200
Madarus bistrigellus	2210110340001021001002101220010121210
Madopterus talpa	0020110121100110211101200001011141210
Megabaris quadriguttata	0100110201010011101110000000011122100
Megavallius auritarsis	0200110411011211000201000200011122110
Melampius basalis	2210110521010021001200000220011122110
Microbaridia delicatula	0200110001111111111111111111111020???
Microcholus puncticollis	0110110011101000110112011210011122322
Microcholus striatus	0100110011111111111111111111111122???
Microforandia uniformis	0200110511111111111111111111111020???
Microrhinus mutilus	1210110311001010001002011210011022001
Microstegotes sp.	1210110521000010000210000021002021110
Microstrates cocois	1210110511001021100001100200011122???
Myctides imberbis	1210110321000011001001101210010022100
Nertinus suturalis	0020110221111000011110200001001021110
Nestrada compacta	1200110101111111111111111111111022???
Nicentrus decipiens	0100110221001011000011200000011122001
Nicentrus grossulus	0100110521001011000100100100011122101
Odontobaris sp.	1100110121111001210210000120011022110
Odontocorynus scutellumalbum	0120110220000011100200100020011122210
Odontocorynus creperus	0120110221100011200100100020011122110
Oligolochus bracatus	0210110000011011000001010220011120011
Oligolochus ornatus	0210110201000111001100010210011120001
Onychobaris densa	2210110220000021000012111210011120000
Oomorphidius leavicollis	1210110021011111111111012100111122322
Opseobaris alba	0020110011111010211200200001001121210
Optatus palmaris	0200111540011021001110010001000121110
Orchidophilus aterrimus	2210110030101020000200011210010121110
Orissus meigenii	1200110211011200201110000001000021110
Orissus christophori	2210110511001210200110010001002022110
Orthoris crotchii	0210110221011010000111111210011120001
Ortycus cristosus	1200110501111111111111111111111022???
Ovanius picipennis	1210110420001111001200000210001122211
Ovanius minutus	1210111110001011001001000220011022211
Pachybaris porosa	2210111001000021001200000210011022001
Pachygeraeus laevirostris	0100110221111011200200000120011122210
Pacomes subglaber	0020110101111111111111111111100121???
Palmelampius heinrichi	1210110511001011101200000110011022001
Pantoteles tenuirostris	0100111520010021200210200021010120???
Parageraeus tumidirostris	0100111411011011001100000120011122210
Parallelosomus amplitarsis	0120110121110110000110200021011121110
Parasaldius sp.	1200110001001011001201100120011122001
Parasomenes curvirostris	1100110001001011000100200110011122100
Pardisomus biplagiatus	0110111420110011000201111001000121110
Parisoschoenus sp.	1210110511000011100201100110011022000
Peclaviopsis planipectus	0210110521111111111111111111111022???
Peridinetus cretaceous	0100110441010020001011201001000121110
Peridinetus irroratus	0100110021010020001211201001000122110
Phacelobarus signubaris	1100110100011010000011110210010022100
Pistus galeatus	0210111520001020100100001001010132010
Platyonyx ornatus	1200110211101111100000100020011101110
Plesiobaris albilata	1110110320011011011202011120011020001
Plocamus echidna	2210110501010020211001010210011120001
Plocamus clavisetes	2210110501001011000012010210011120001
Prodinus sp.	0110110220011001200201000000011022210
Pseudobaris angusta	1210110120111011001001200120011022000
Pseudocentrinus ochraceus	0100110211001011000200100121011120110
Pseudogeraeus macropterus	0220110201100000201110100000011020110
Pseudorthoris devexus	0200110521011011101010200120011120201
Pseudotorcus rufipes	0200110111101011101100100020011122010

Psiona densa	01101114?????????????????????01020???
Pteracanthus smidtii	01001115200100100001010000210001221l0
Pycnogeraeus modestus	01201102010011200011000001000111221l0
Pycnogeraeus striatirostris	02101105010011201001010002000111220l1
Pycnonicentrus gilvivestis	01101101l?????????????????????11002???
Pycnotheantis sp.	12001104200110210011000101200110201l0
Ranceoma uniformis	01001101l?????????????????????11022???
Remertus marginatus	22101102??????????????????????11122???
Ravena sexualis	12101104?????????????????????1011022???
Reveniopsis sp.	22101103?????????????????????0011022???
Rhoptobaris canescens	02101105200111100012002012100110202l1
Saldiopsis armata	02101104?????????????????????11020???
Saldius inaequalis	02101104l?????????????????????11020???
Selasella cuneipennis	22001104l?????????????????????11022???
Sibariops concinna	12101100110010210000112002100111220l1
Sibariops concurrens	12101104100010110001000002200111220l1
Solaria curtula	22101103200010210011010112100100202l0
Solenosternus dividuus	12101100101010210010121012100110202l0
Somenes regestus	01101101l?????????????????????11122???
Stereobaris interpunctata	02101101110000101000020012200110201l0
Stethobaris commixta	22001101101012112011000002200010222l1
Stethobaris laevimargo	12101111111010112012010002100110222l0
Stethobaroides nudiventris	12101111111012211012000002200110222l1
Stethobaropsis titara	02001110l?????????????????????11022???
Strongylotes squamans	00201100211100100111112000010111211l0
Telemus sp.	02101110200100200100100110010001211l0
Tenemotes abdominalis	02101105210011102011102000010010022l0
Tenemotes parviclava	02101105200011112011100000010010022l1
Thaliabaris inermis	12101104?????????????????????0011122???
Torcobius sp.	02101111201110111010011002200111220l1
Torcus nigrinus	20201102211010100101011000210111212l0
Torcus variabilis	22001105100110110001012000100111220l1
Trachymeropsis palmipes	11201101211120101110002000210010212l0
Trichodirabius longulus	12001105200010211001001002100111221l0
Valdenus laevis	01201101l?????????????????????11122???
Valiopsis squamipes	02101102211111110012100001000112221l0
Vallius sulcatus	12101105?????????????????????00021???
Xystus ater	12101105200112002001100000010100212l0
Xystus ruficollis	02101105210112002001100100010020222l0
Zena virgata	01001105001000200000010011100011221l0
Zygobarella xanthoxyli	12001100010010110002000102100010220l1
Zygobarella tristicula	22101105210010110002000102100011220l1
Zygobarinus coelestinus	22001103?????????????????????0001122???
Zygobaris sp. 1	02101101210110110010100001200110200l1
Zygobaris nitens	12101100110001210002000102200010220l0
Zygobaris sp.	11101100210010110000010002000111220l1
Zygozalestes oblongus	11001100?????????????????????11022???
Anatorcus densus	1??011040?????????????????????11122???
Andiblis seriata	1??011030?????????????????????01042???
Aniops sculpturata	0??011060?????????????????????01132???
Anotesiops obidosensis	2??011010?????????????????????11022???
Calorida binocularis	0??011041?????????????????????11021???
Camerones semiopacus	1??011042?????????????????????11022???
Chepagra rotundicollis	0??011022?????????????????????11122???
Clandius cephalotes	0??011040?????????????????????11022???
Crostis subexplanata	0??012050?????????????????????11020???
Dericinus habilis	1??011051?????????????????????11022???
Ethelda Squamosa	0??011030?????????????????????01022???
Eudialomia longula	2??011042?????????????????????11120???
Forandia duplex	0??011022?????????????????????11101???
Forandiopsis carinulata	0??012052?????????????????????11002???
Iopsidaspis truncatula	1??011042?????????????????????11132???
Leptogarnia polita	1??011054?????????????????????01020???
Leptoladustes densus	1??011052?????????????????????11120???
Linogarnia suturalis	0??011061?????????????????????01020???
Microtorcus tubulatus	0??011041?????????????????????11122???
Microzalestes basalis	1??011041?????????????????????11022???

Nedestes sarpedon	1??012052??????????????????????11001???
Neplaxa illustris	0??000221??????????????????????10161???
Nicentridia angusticollis	0??011030??????????????????????11122???
Palocopsis tecta	0??011030??????????????????????01022???
Parafishonia setulosa	1??011040??????????????????????11122???
Peclavia hispidicollis	1??011040??????????????????????11022???
Pseudorancea spissirostris	0??011042??????????????????????01022???
Pseudosaldius conjunctus	0??011052??????????????????????11120???
Rancea parviclava	0??011142??????????????????????11021???
Roalius rufipes	3??011021??????????????????????00122???
Sibariopsida docilis	0??011040??????????????????????11120???
Sodesia sparsa	1??011040??????????????????????11120???
Spolatia gradata	1??011010??????????????????????00132???
Starcus rugulosus	1??011042??????????????????????11120???
Sunilius platyrhinhus	2??011001??????????????????????11022???
Ternova biartita	0??011054??????????????????????11122???
Thestonia sparsa	0??011002??????????????????????01022???
Zalestes perpolitus	1??011002??????????????????????11122???
Cymatobaris impressifrons	12101101110010212000010012200111221 10
Pacomes distortus	00201104211102112011012010010001211 10
Megalobaris viridana	01101106010010202012011012200110221 00
Rhytidoglymma cenescens	22101106110010210002001012100011321 10
Craptus tibialis	12101105201010201010012012100010321 00
Testalthea sp.	12101103010101211002010000010010302 10
Barycerus collaris	02101100210100210012010012200110301 00
Opertes sp.	12101106210010210002020012100110321 00
Stictobaris cribrata	01001102210010110001011012100111001 00
Moreobaris deplanata	22101106100010100001001012100110202 00
Ulobaris loricata	01001105201110112002000111100111202 00
"Neomadarini"	12101100010010210002001002200110210 01
Trichobaris texana	01001105201010110002102012100011201 00
Dalcesia sp.	01001106202110111002021012200110201 00
Nanobaris sp.	12101106200010110001110012100010202 01
Zathanius sp.	02101106201010200002001012100110201 10
Allomegops sp.	12101105201100110001012012100011202 10
Deipyle induta	22101106200100200000201001210011020 200
Cosmobaris americana	01101101001010110001122012100110202 00
Thanius sp.	22001106200110210002011012100010221 10
Cryptosternum nevermanni	12101106?????????????????????010162???
Pycnobaris pruinosa	12101105010010110012010012100111201 10
Tonesia sp.	22101102210010200010110002100111002 00
Trepobaris inornata	11001106200010110000122011200100201 00
Hiotus inflatus	12001102010110010011110000000110221 10
Sphenobaris quadridens	22101103300010100002020012100101222 00
Coluthus cribrarius	11001105200110110002002000200111221 01
Aniops sp.	01001100010110010000102001210011322 11
Montella rufipes	021011030??????????????012?0001122???
Palmocentrinus butia	120011052??????????????0?2?0011102???
Bondariella mimica	120011010??????????????0?2?0011122???
Eucalus vitticolis	300000202??????????????0?1?0031120???
Scirpicola chilensis	300001311??????????????1?0?1011122???
Ortycus setifer	12101105210110200002010000010111221 10

Appendix I (continued). Character matrix - characters 74 - 110. $ = [2,3].

	74	79	84	89	94	99	104	109
	|	|	|	|	|	|	|	|
Dryophthorinae (Dryophthorus americanus)	00000120001130021000000000000002?10201							

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Bagoinae (Bagous transversus)                1000010100111103100000000000000301????
Conoderinae (Cylindrocopturus operculatus) 0110110201010005100000001111110301????
Conoderinae (Trichodocerus sp.)              1000211200000003000000000000000002110202
Conoderinae (Arachnopus gazella)             2222322000014000000000000000005??0102
Conoderinae (Cyllophorus fausciatus)         0110210100010103100000000000002??0111
Conoderinae (Metialma straminea)             0110200111002004110000000000002010202
Conoderinae (Balanogastris kolae)            1000210101010002101110001110002110201
Conoderinae (Telephae oculata)               1000110101010002101110001110002??0102
Conoderinae (Cylindrocopturus adspersus)    0000110101010003100000000000002010101
Conoderinae (Acoptus suturalis)              0000110100020003100000000000002111202
Conoderinae (Lobotrachelus troglodytes)     0000111011020103100000000000000211????
Conoderinae (Mecopus trilineatus)            1010200200015003100000000000002110102
Ceutorhynchinae (Ceutorhynchus obstrictus) 1110000011012104110000000000002??0101
Ceutorhynchinae (Hypurus bertrandi)          0000000211012103110000000000002??0112
Ceutorhynchinae (Phytobius oriseomicans)    0000103111015004100000000000003110003
Ceutorhynchinae (Mononychus vulpeculus)     0110110211015102100000000000002010102
Ceutorhynchinae (Auleutes argentinensis)    0000100111012003100000000000002010131
Ceutorhynchinae (Coeliodes flavicaudis)     0110100211012003100000000000002010102
Curculioninae (Curculio pardalis)            0010210100112002100000000000001??0111
Molytinae (Cholus rana)                      0110111200010005100000000000002??0032
Molytinae (Trigonocolus curvipes)            1110213111112016110000000000006011210
Molytinae (Conotrachelus fissunguis)         1000212000110004000000000000003100102
Entiminae (Cyrtepistomus castanaeus)         1110212000110003100000000000000310????
Derelominae (Derelomus basalis)              2222322000110004101110001111002010111
Cryptorhynchinae (Cryptorhynchus lapathi)  1110211000101004100000000000003010131
Orobitidinae (Parorobitis gibbus)            1000110111012012100000001110001??0111
Acentrinops brevicollis                      0000001000010111011111111111100210????
Amercedes subulirostris                      0000111000010l1?01?????????????010110
Amercedes orthorrhinus                       0000111100010l1?01?????????????010111
Anavallius ruficornis                        1010110100012111001111111111003011111
Anopsilus oblongus                           0000110111013111011100001111111011232
Antesis sparsa                               0000111110010111211110001111002000022
Athesapeuta vinculata                        0000110011011012101100001111112001032
Barilepsis griseus                           0000110100012111011111001111002100102
Barilepton filiforme                         2222320000010112101111001111003010031
Barilepton quadrieolle                       0000110000010012111111001111003010031
Barinus bivittatus                           0000000000010002201111001111003000031
Barinus cribricollis                         0000001000010101001111001111002010031
Baris torquata                               0010110211014111001110001111112000120
Barymerus binaries                           1010210111000011001111111111100311????
Buchananius striatus                         0000012100010102101111101111101000121
Buchananius sulcatus                         0000012000010112101111101111101010101
Busckiella lecythidis                        0010212211012012011111111111112011101
Calandrinus grandicollis                     2222321000000103000000001110004000122
Camelodes leachii                            1010112200010011?011100011111003??0100
Catapastinus caseyi                          0000110100??????????????????????00????
Catapastus conspersus                        ??????1000010111011111001111003010112
Catapastus squamirostris                     0000111100010111011111001111002010112
Catapastus albonotatus                       ??????1100010111001111001111002000101
Catapastus diffusus                          ??????1100010111011111001111002010112
Catapastus seriatus                          0000111100010111101111001111002000101
Catapastus signatipennis                     0000000100010111001111001111002000101
Catapastus simplex                           ??????1100010111??111100l111002000101
Centrinites strigicollis                     0000111100010112001110001111003000220
Centrinogyna hispidula                       0000111000011102101110001110030?????
Centrinogyna strigata                        0000010010011102011110001111003010030
Centrinopsis sp.                             0000112000012112101111111111003010030
Centrinopus alternatus                       0000010100010111001110001111001010200
Centrinopus helvinus                         0000110100010112001110001111003010202
Centrinus curvirostris                       1010110200010112001111101111003110101
Coelonertus nigrirostris                     0000110000010001100000001111100300????
Coleomerus boliviensis                       1010111110012111011100001111002000101
Conoproctus quadripustulatus                 0010112011012011011111111111102??11$1
Crostidia tenuipes                           ??????0000000??????????????????????
Crotanius trivittatus                        1010110100010111001100001111003??0112
Cylindridia prolixa                          1000111110011103001110001111020?0110
Cylindrocerus comma                          1010211100010111001111001111111010221
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Cyrionyx camelus	10101102000141111011000011100020012 00
Dactylocrepis flabellitarsis	??????020000011?00??????????????????
Dealia carbonarius	??????000001100??????????????????????
Deipyrus hirsutulus	000011200001011?00?????????????????0111
Demoda vittata	10102101000100112111110011111003??0101
Desmoglyptus arizonicus	000011220000411210111000111111201112 0
Dialomia gradata	??????10000100??????????????????????
Diastethus eurthinoides	10101122000101111010000011110020102 01
Dimesus rubricatus	10001101000101110111110011111113010112
Diorymeropsis disjuncta	00101111000101110011100111110020 1????
Diorymeropsis xanthoxyli	00101111000101111111110011111002 00????
Diorymerus lancifer	11102121000000121011111111111111??0111
Dirabius calvus	00101101000100120011110011111002000010
Dirabius rectirostris	00101111110100122011110011110002000010
Dissopygus metallescens	00101112110140121111100011111112001111
Eisonyx crassipes	22223210000110021000000011111120?0230
Eisonyx opaca	22223200000141031000000011111103000130
Elasmobaris signifer	??????00000131??????????????????????
Embates chaetopus	11102102000100110011100011100030002 01
Eugeraeus sp.	10101132000101111011100111100310????
Eumycterus albosquamulatus	000000101100210?100000000000000???1131
Eurhinus festivus	00102101110121111111100011111111001211
Eurhinus aeneus	00101101110141111111100011111111011231
Eusomenes curtirostris	??????10100100??????????????????????
Eutoxus sp.	10102111000101110111111111111102??0221
Fishonia brevinasus	??????10000101??????????????????????
Fryella mutilatus	??????2210013 0???0??????????????????
Garnia sp.	10101121000100110111111111111113??0131
Geraeopsis duplocincta	??????02000100??????????????????????
Geraeus lineellus	00000101000141112111100011111002000110
Geraeus penicella	00101101000101110111100011111002010211
Glyptobaris lecontei	00000111000021130011111111111112000220
Haplostethops ellipsoidea	00000111000101020011111111111300??????
Idiostethus subcalvus	10001111000101020011111111111103000112
Idiostethus tubulatus	00001110100101020011110011111003000112
Iops bicolor	??????20010121131011110111111113??0121
Ladustaspis crocopelmus	??????01000101111010000111100310????
Lampobaris cicullata	10101121000141130011111111111113??1101
Lasiobaris geminata	10101110000100121011111111111113??0031
Laurentius bruchi	??????02000100??????????????????????
Lepidobaris acnisti	00101122110140121011000011111112000110
Leptoschoinus fucatus	10001102110121111011100001111102??0102
Lichnus longulus	00100011110011131011110011111112011131
Limnobaris bicincta	00000100000120110011000011111002??0131
Limnobaris calandriformis	00000110100100112011100011111002000202
Linogeraeus urbanus	00001101000100112111100011111002000210
Linogeraeus viduatus	00101102000101112011100011111002000100
Linomadarus vorticosus	00001102111021110111100011111112001131
Lipancylus brevirostris	10112131110020130111111011111113010132
Loboderes citriventris	00101100110120110111100011111101??0222
Lorena simulans	??????11000100??????????????????????
Lydamis cinnamomeus	11102102000100111011100011100031?0200
Macrobaris sp.	10100110000001141011110011111113010131
Macrorevena atromicans	??????02000110 1?10??????????????????
Madarellus laticollis	00001122110121110111100011111111011221
Madarus bistrigellus	00001111110121111111000011111111001121
Madopterus talpa	10112112110131130011111111111113010131
Megabaris quadriguttata	00101102100101112111100011111003100022
Megavallius auritarsis	10102102000101120111111111111110201????
Melampius basalis	10102111000101122011110011111002??0111
Microbaridia delicatula	??????1100??????????????????????????
Microcholus puncticollis	22223200000110030000000000000030?0101
Microcholus striatus	??????10000101??????????????????????
Microforandia uniformis	??????30000100??????????????????????
Microrhinus mutilus	00001110110120121011000011111102011112
Microstegotes sp.	10101122000101120011000011111101??0211
Microstrates cocois	??????00100120111111110011111002100131

Myctides imberbis	0000110111012012111110001111111?1232
Nertinus suturalis	1010210100013111111111111111113100231
Nestrada compacta	??????3100010????????????????????????
Nicentrus decipiens	0000000000010112211110001111002000102
Nicentrus grossulus	0000110100010111211110001111002??0112
Odontobaris sp.	0010110011010112101111111111113110112
Odontocorynus scutellumalbum	1010110011010111001100001111002000101
Odontocorynus creperus	1010110100010011001100001111002000012
Oligolochus bracatus	0000111100011112001111101111103111102
Oligolochus ornatus	0000011100010111101111001111002?1????
Onychobaris densa	0000110111013111011100001111112011221
Oomorphidius leavicollis	2222320000010004101110001111003000101
Opseobaris alba	1010210110010111111111111111113010131
Optatus palmaris	1110210200010011111111001110002?0????
Orchidophilus aterrimus	0000110000012111001111111111111211????
Orissus meigenii	1010210200010111101100001111111010220
Orissus christophori	1010212100010111101000001111002010201
Orthoris crotchii	0000000011014112101110001111112111231
Ortycus cristosus	??????1200010????????????????????????
Ovanius picipennis	0000011000011111001111111111113100111
Ovanius minutus	0000010100000111101111111111112010001
Pachybaris porosa	1000111000010111201111101111002??0211
Pachygeraeus laevirostris	1010110200010102001111001111002??0101
Pacomes subglaber	??????1211110????????????????????????
Palmelampius heinrichi	0010113000012011011111111111102??0122
Pantoteles tenuirostris	??????0200010011101100001110002011102
Parageraeus tumidirostris	1010111100010113201110001111002?1????
Parallelosomus amplitarsis	1011210011011113011111111111113110111
Parasaldius sp.	1010110110010111001110001111002??0201
Parasomenes curvirostris	1010111001010111111111001111002??0???
Pardisomus biplagiatus	1010110200010012101110001110003000202
Parisoschoenus sp.	0000113111012011011111111111102010132
Peclaviopsis planipectus	??????1000010????????????????????????
Peridinetus cretaceous	1111112200014012101111001110002000200
Peridinetus irroratus	1111210200010012101111101110002??0200
Phacelobarus signubaris	0101110100004011111110001111101??1131
Pistus galeatus	1010110200010111101100001110001011200
Platyonyx ornatus	0010110101000113001100001111003100102
Plesiobaris albilata	0000011010002105000000001111114011222
Plocamus echidna	0000011000010011101000001111001110201
Plocamus clavisetes	0000002000011111101111001111001000022
Prodinus sp.	1010110100002111001111111111113010201
Pseudobaris angusta	0000003011003111001100001111002??1212
Pseudocentrinus ochraceus	1010110100010111101111001111002100022
Pseudogeraeus macropterus	1010110111012111011110001111003000200
Pseudorthoris devexus	0000001111011111?????????????????????0031
Pseudotorcus rufipes	1010110100010111201111001111002000111
Psiona densa	??????2100000????????????????????????
Pteracanthus smidtii	1111211200011112101111001110002001101
Pycnogeraeus modestus	1010110111010112?01?????????????1111
Pycnogeraeus striatirostris	0010001100010111211110001111002100001
Pycnonicentrus gilvivestis	??????0100????????????????????????????
Pycnotheantis sp.	1010111100010111101110001111003112???
Ranceoma uniformis	??????1100000????????????????????????
Remertus marginatus	??????0100010????????????????????????
Ravena sexualis	??????0100010011211111001111003??0111
Reveniopsis sp.	??????1200000111001111001111003??0211
Rhoptobaris canescens	0000110011014112101110001111112011230
Saldiopsis armata	??????1100010????????????????????????
Saldius inaequalis	??????1000010????????????????????????
Selasella cuneipennis	??????1100010????????????????????????
Sibariops concinna	0000001000000011101110001111002??0???
Sibariops concurrens	0000111100010111011110001111003??0???
Solaria curtula	0000111111013111001100001111113000031
Solenosternus dividuus	0000111011012011011100001111113011222
Somenes regestus	??????1101010????????????????????????
Stereobaris interpunctata	0010111211014011111110001111112001121

Stethobaris commixta	00000000000101111111110011111101100020
Stethobaris laevimargo	00101010000101121011111111111112000101
Stethobaroides nudiventris	00001110110041111111111111111112?0021
Stethobaropsis titara	??????1100010???????????????????????
Strongylotes squamans	10102102100100121011111111111111211????
Telemus sp.	11102122000100111011100011100021???
Tenemotes abdominalis	11102102000101111111111111111111210????
Tenemotes parviclava	10101102000101131011111111111121?????
Thaliabaris inermis	??????1011012??11???????????????????
Torcobius sp.	00001011000000112010000011110002??1131
Torcus nigrinus	10101100110100022000000011111102??0012
Torcus variabilis	10001010000101022100000011111103010202
Trachymeropsis palmipes	00100111000101121011111111111111310????
Trichodirabius longulus	00001110000101120011110011110002010111
Valdenus laevis	??????2111001???????????????????????
Valiopsis squamipes	10102102000121122011111111111002??0110
Vallius sulcatus	??????2100000112?00???????????????????
Xystus ater	10101102000101110010000011111003000200
Xystus ruficollis	1010110200000011001000001111003??0101
Zena virgata	00101101110140121011000011111112010031
Zygobarella xanthoxyli	00000111000101112?00?????????????000221
Zygobarella tristicula	0000111100010112?00?????????????000221
Zygobarinus coelestinus	??????1101013??????????????????????
Zygobaris sp. 1	00000011000101112011100111110010001
Zygobaris nitens	10101110000101?00?????????????????0100
Zygobaris sp.	00000010000101112011100111110030011
Zygozalestes oblongus	??????1100010???????????????????????
Anatorcus densus	??????1101000012??????????????????????
Andiblis seriata	??????1100010112??????????????????????
Aniops sculpturata	??????1100010112??????????????????????
Anotesiops obidosensis	??????1101010112??????????????????????
Calorida binocularis	??????0200010012??????????????????????
Camerones semiopacus	??????1100010012??????????????????????
Chepagra rotundicollis	??????0100010012??????????????????????
Clandius cephalotes	??????1100010112??????????????????????
Crostis subexplanata	??????3001010??????????????????????
Dericinus habilis	??????1000010012??????????????????????
Ethelda Squamosa	??????1100010012??????????????????????
Eudialomia longula	??????1100010012??????????????????????
Forandia duplex	??????0110012012??????????????????????
Forandiopsis carinulata	??????0100020112??????????????????????
Iopsidaspis truncatula	??????1100000112??????????????????????
Leptogarnia polita	??????0100010012??????????????????????
Leptoladustes densus	??????0100010112??????????????????????
Linogarnia suturalis	??????0100010012??????????????????????
Microtorcus tubulatus	??????1100010012??????????????????????
Microzalestes basalis	??????1100010112??????????????????????
Nedestes sarpedon	??????0210010012??????????????????????
Neplaxa illustris	??????0000010002??????????????????????
Nicentridia angusticollis	??????0100010112??????????????????????
Palocopsis tecta	??????0100020112??????????????????????
Parafishonia setulosa	??????1100010012??????????????????????
Peclavia hispidicollis	??????1100010012??????????????????????
Pseudorancea spissirostris	??????1100010112??????????????????????
Pseudosaldius conjunctus	??????0100010012??????????????????????
Rancea parviclava	??????1100010112??????????????????????
Roalius rufipes	??????0100010012??????????????????????
Sibariopsida docilis	??????1100010012??????????????????????
Sodesia sparsa	??????1100010112??????????????????????
Spolatia gradata	??????1110014012??????????????????????
Starcus rugulosus	??????1000010012??????????????????????
Sunilius platyrhinhus	??????1100010112??????????????????????
Ternova biartita	??????1100010112??????????????????????
Thestonia sparsa	??????0000010112??????????????????????
Zalestes perpolitus	??????0100010012??????????????????????
Cymatobaris impressifrons	00101122110140121111100011111111001120
Pacomes distortus	10102112100011140011111111111112100112

Megalobaris viridana	00101102110141121111100011111112001123
Rhytidoglymma cenescens	00101112100131141011100011111120?????
Craptus tibialis	00001102110130120111000011111111011202
Testalthea sp.	10101101000121140011111011111113010101
Barycerus collaris	00101102110141111111100011111110001133
Opertes sp.	00102102110121120111000011111111011201
Stictobaris cribrata	00101111110131121011100011111111001101
Moreobaris deplanata	00001112110141121011100011111111001210
Ulobaris loricata	00001011110121120011100011111111000131
"Neomadarini"	00101011110101112011110011111000110012
Trichobaris texana	00101101110140131010000011111112010130
Dalcesia sp.	00101102110120111011100011111112001212
Nanobaris sp.	00000111110130121011100011111112001132
Zathanius sp.	00001131110121121011000011111111001102
Allomegops sp.	00101132110120121011000011111111??1111
Deipyle induta	00001131100120121011100011111111011232
Cosmobaris americana	00001100100111120011100011111101101111
Thanius sp.	00101112110131111111000011111110??1202
Cryptosternum nevermanni	??????110001311??????????????????????????
Pycnobaris pruinosa	00001101110131110011100011111111000032
Tonesia sp.	00101111000101112011110011111000??0232
Trepobaris inornata	00001111110121120011000011111111001212
Hiotus inflatus	10101101000001111010000011111111011????
Sphenobaris quadridens	00001131100021121011111111111111111????
Coluthus cribrarius	00101111000101122011000011111001??1101
Aniops sp.	00001011000101130011110011111112000102
Montella rufipes	??????100001011210111111111111111??0121
Palmocentrinus butia	??????111101201321111111111111102??0212
Bondariella mimica	??????010001011320111100111100 2??0101
Eucalus vitticolis	??????011101200401000000111111 3010122
Scirpicola chilensis	??????010001000300111111111111112010131
Ortycus setifer	10102112000101110011111111111110110132

Appendix I (continued). Character matrix - characters 111 – 112.

	111
	|
Dryophthorinae (Dryophthorus americanus)	00
Bagoinae (Bagous transversus)	??
Conoderinae (Cylindrocopturus operculatus)	??
Conoderinae (Trichodocerus sp.)	13
Conoderinae (Arachnopus gazella)	00
Conoderinae (Cyllophorus fausciatus)	00
Conoderinae (Metialma straminea)	14
Conoderinae (Balanogastris kolae)	10
Conoderinae (Telephae oculata)	10
Conoderinae (Cylindrocopturus adspersus)	00
Conoderinae (Acoptus suturalis)	00
Conoderinae (Lobotrachelus troglodytes)	??
Conoderinae (Mecopus trilineatus)	00
Ceutorhynchinae (Ceutorhynchus obstrictus)	12
Ceutorhynchinae (Hypurus bertrandi)	02
Ceutorhynchinae (Phytobius oriseomicans)	04
Ceutorhynchinae (Mononychus vulpeculus)	00
Ceutorhynchinae (Auleutes argentinensis)	04
Ceutorhynchinae (Coeliodes flavicaudis)	00
Curculioninae (Curculio pardalis)	00

Molytinae (Cholus rana)	14
Molytinae (Trigonocolus curvipes)	10
Molytinae (Conotrachelus fissunguis)	00
Entiminae (Cyrtepistomus castanaeus)	??
Derelominae (Derelomus basalis)	00
Cryptorhynchinae (Cryptorhynchus lapathi)	10
Orobitidinae (Parorobitis gibbus)	04
Acentrinops brevicollis	??
Amercedes subulirostris	10
Amercedes orthorrhinus	10
Anavallius ruficornis	10
Anopsilus oblongus	10
Antesis sparsa	10
Athesapeuta vinculata	12
Barilepsis griseus	10
Barilepton filiforme	00
Barilepton quadrieolle	00
Barinus bivittatus	00
Barinus cribricollis	00
Baris torquata	12
Barymerus binaries	??
Buchananius striatus	10
Buchananius sulcatus	00
Busckiella lecythidis	00
Calandrinus grandicollis	00
Camelodes leachii	10
Catapastinus caseyi	??
Catapastus conspersus	00
Catapastus squamirostris	00
Catapastus albonotatus	00
Catapastus diffusus	00
Catapastus seriatus	10
Catapastus signatipennis	10
Catapastus simplex	10
Centrinites strigicollis	10
Centrinogyna hispidula	??
Centrinogyna strigata	10
Centrinopsis sp.	00
Centrinopus alternatus	10
Centrinopus helvinus	10
Centrinus curvirostris	10
Coelonertus nigrirostris	??
Coleomerus boliviensis	00
Conoproctus quadripustulatus	00
Crostidia tenuipes	??
Crotanius trivittatus	10
Cylindridia prolixa	10
Cylindrocerus comma	00
Cyrionyx camelus	00
Dactylocrepis flabellitarsis	??
Dealia carbonarius	??
Deipyrus hirsutulus	10
Demoda vittata	10
Desmoglyptus arizonicus	00
Dialomia gradata	??
Diastethus eurthinoides	10
Dimesus rubricatus	00
Diorymeropsis disjuncta	??
Diorymeropsis xanthoxyli	??
Diorymerus lancifer	00
Dirabius calvus	10
Dirabius rectirostris	10
Dissopygus metallescens	10
Eisonyx crassipes	02
Eisonyx opaca	10
Elasmobaris signifer	??
Embates chaetopus	10

Eugeraeus sp.	??
Eumycterus albosquamulatus	?0
Eurhinus festivus	00
Eurhinus aeneus	10
Eusomenes curtirostris	??
Eutoxus sp.	10
Fishonia brevinasus	??
Fryella mutilatus	??
Garnia sp.	00
Geraeopsis duplocincta	??
Geraeus lineellus	00
Geraeus penicella	10
Glyptobaris lecontei	10
Haplostethops ellipsoidea	??
Idiostethus subcalvus	00
Idiostethus tubulatus	10
Iops bicolor	00
Ladustaspis crocopelmus	??
Lampobaris cicullata	10
Lasiobaris geminata	00
Laurentius bruchi	??
Lepidobaris acnisti	10
Leptoschoinus fucatus	02
Lichnus longulus	10
Limnobaris bicincta	10
Limnobaris calandriformis	10
Linogeraeus urbanus	10
Linogeraeus viduatus	10
Linomadarus vorticosus	10
Lipancylus brevirostris	10
Loboderes citriventris	00
Lorena simulans	??
Lydamis cinnamomeus	00
Macrobaris sp.	00
Macrorevena atromicans	??
Madarellus laticollis	12
Madarus bistrigellus	00
Madopterus talpa	10
Megabaris quadriguttata	10
Megavallius auritarsis	??
Melampius basalis	00
Microbaridia delicatula	??
Microcholus puncticollis	00
Microcholus striatus	??
Microforandia uniformis	??
Microrhinus mutilus	10
Microstegotes sp.	10
Microstrates cocois	00
Myctides imberbis	00
Nertinus suturalis	10
Nestrada compacta	??
Nicentrus decipiens	10
Nicentrus grossulus	10
Odontobaris sp.	10
Odontocorynus scutellumalbum	10
Odontocorynus creperus	10
Oligolochus bracatus	10
Oligolochus ornatus	??
Onychobaris densa	00
Oomorphidius leavicollis	10
Opseobaris alba	10
Optatus palmaris	??
Orchidophilus aterrimus	??
Orissus meigenii	10
Orissus christophori	10
Orthoris crotchii	10
Ortycus cristosus	??

Ovanius picipennis	12
Ovanius minutus	00
Pachybaris porosa	10
Pachygeraeus laevirostris	00
Pacomes subglaber	??
Palmelampius heinrichi	00
Pantoteles tenuirostris	00
Parageraeus tumidirostris	??
Parallelosomus amplitarsis	10
Parasaldius sp.	10
Parasomenes curvirostris	??
Pardisomus biplagiatus	10
Parisoschoenus sp.	10
Peclaviopsis planipectus	??
Peridinetus cretaceous	10
Peridinetus irroratus	00
Phacelobarus signubaris	10
Pistus galeatus	00
Platyonyx ornatus	10
Plesiobaris albilata	10
Plocamus echidna	00
Plocamus clavisetes	00
Prodinus sp.	00
Pseudobaris angusta	10
Pseudocentrinus ochraceus	10
Pseudogeraeus macropterus	00
Pseudorthoris devexus	10
Pseudotorcus rufipes	10
Psiona densa	??
Pteracanthus smidtii	00
Pycnogeraeus modestus	10
Pycnogeraeus striatirostris	11
Pycnonicentrus gilvivestis	??
Pycnotheantis sp.	??
Ranceoma uniformis	??
Remertus marginatus	??
Ravena sexualis	00
Reveniopsis sp.	00
Rhoptobaris canescens	10
Saldiopsis armata	??
Saldius inaequalis	??
Selasella cuneipennis	??
Sibariops concinna	??
Sibariops concurrens	??
Solaria curtula	00
Solenosternus dividuus	10
Somenes regestus	??
Stereobaris interpunctata	10
Stethobaris commixta	02
Stethobaris laevimargo	02
Stethobaroides nudiventris	02
Stethobaropsis titara	??
Strongylotes squamans	??
Telemus sp.	??
Tenemotes abdominalis	??
Tenemotes parviclava	??
Thaliabaris inermis	??
Torcobius sp.	10
Torcus nigrinus	00
Torcus variabilis	10
Trachymeropsis palmipes	??
Trichodirabius longulus	10
Valdenus laevis	??
Valiopsis squamipes	10
Vallius sulcatus	??
Xystus ater	10
Xystus ruficollis	00

Zena virgata	01
Zygobarella xanthoxyli	00
Zygobarella tristicula	00
Zygobarinus coelestinus	??
Zygobaris sp. 1	10
Zygobaris nitens	00
Zygobaris sp.	00
Zygozalestes oblongus	??
Anatorcus densus	??
Andiblis seriata	??
Aniops sculpturata	??
Anotesiops obidosensis	??
Calorida binocularis	??
Camerones semiopacus	??
Chepagra rotundicollis	??
Clandius cephalotes	??
Crostis subexplanata	??
Dericinus habilis	??
Ethelda Squamosa	??
Eudialomia longula	??
Forandia duplex	??
Forandiopsis carinulata	??
Iopsidaspis truncatula	??
Leptogarnia polita	??
Leptoladustes densus	??
Linogarnia suturalis	??
Microtorcus tubulatus	??
Microzalestes basalis	??
Nedestes sarpedon	??
Neplaxa illustris	??
Nicentridia angusticollis	??
Palocopsis tecta	??
Parafishonia setulosa	??
Peclavia hispidicollis	??
Pseudorancea spissirostris	??
Pseudosaldius conjunctus	??
Rancea parviclava	??
Roalius rufipes	??
Sibariopsida docilis	??
Sodesia sparsa	??
Spolatia gradata	??
Starcus rugulosus	??
Sunilius platyrhinhus	??
Ternova biartita	??
Thestonia sparsa	??
Zalestes perpolitus	??
Cymatobaris impressifrons	12
Pacomes distortus	00
Megalobaris viridana	10
Rhytidoglymma cenescens	??
Craptus tibialis	10
Testalthea sp.	00
Barycerus collaris	12
Opertes sp.	10
Stictobaris cribrata	02
Moreobaris deplanata	00
Ulobaris loricata	12
"Neomadarini"	10
Trichobaris texana	12
Dalcesia sp.	12
Nanobaris sp.	10
Zathanius sp.	10
Allomegops sp.	10
Deipyle induta	10
Cosmobaris americana	12
Thanius sp.	10
Cryptosternum nevermanni	??

Pycnobaris pruinosa	12
Tonesia sp.	10
Trepobaris inornata	10
Hiotus inflatus	??
Sphenobaris quadridens	??
Coluthus cribrarius	10
Aniops sp.	10
Montella rufipes	00
Palmocentrinus butia	10
Bondariella mimica	00
Eucalus vitticolis	00
Scirpicola chilensis	10
Ortycus setifer	10

Figure captions

Figs. 1-13. 1-9, adult images. 1, *Barinus bivittatus* (dorsal view); 2, *Orissus christophori* (dorsal view); 3, *Orissus meigenii* (lateral view); 4, *Nertinus suturalis* (lateral view); 5, *Parallelosomus amplitarsis* (lateral view); 6, *Peridinetus suturalis* (dorsal view); 7, *Loboderes citriventris* (dorsal view); 8, *Madarellus laticollis* (dorsal view); 9, *Prodinus* sp. (lateral view). 10-13, adult head and rostrum, lateral view. 10, *Centrinogyna strigata*; 11, *Pardisomus biplagiatus*; 12, *Strongylotes squamans*; 13, *Myctides imberbis*.

Figs. 14-17. Antennae. 14-15, *Oligolochus bracatus*; 15, enlargement of apical end; 16-17, *Camelodes leachii*; 17, enlargement of apical end.

Figs. 18-26. Mouthparts. 18, *Oligolochus ornatus*, right mandible; 19, *Plocamus clavisetes*, right mandible; 20, *Eisonyx opaca*, right mandible; 21, *Parallelosomus*

amplitarsis, right mandible; 22, *Torcus nigrinus*, right mandible; 23, *Coleomerus boliviensis*, right mandible; 24, *Oligolochus bracatus*, right maxilla; 25, *Anthinobaris* sp., right maxilla; 26, *Loboderes citriventris*, right maxilla.

Figs. 27-33. 27-32, mouthparts. 27, *Linogeraeus viduatus*, right maxilla; 28, *Xystus ruficollis*, right maxilla; 29, *Anthinobaris* sp., labium; 30, *Linogeraeus viduatus*, labium; 31, *Loboderes citriventris*, labium; 32, *Microcholus punticollis*, labium; 33, *Peridinetus irroratus*, head and rostrum (anterior aspect).

Figs. 34-43. 34, *Pertorcus* sp.; 35, *Odontocorynus creperus*; 36, *Pachybaris porosa*. 37-38, *Centrinus curvirostris*. 37, adult lateral view; 38, prosternum; 39, *Orissus meigenii*, horn sheath; 40, *Demoda vittata*, horn sheath; 41, *Demoda vittata*, adult lateral view; 42-43, *Eutoxus* sp.; 42, adult lateral view; 43, prosternum.

Figs. 44-54. 44-45, *Geraeus lineellus*. 44, adult lateral view; 45, prosternum; 46, *Catapastus squamirostris*, pronotum (SEM); 47, *Trichodirabius longulus*, pronotum (SEM); 48, *Vallius sulcatus*, adult lateral view; 49-51, posterior margin of pronotum and mesoscutellum. 49, *Trichodirabius longulus*; 50, *Pycnogeraeus modestus*; 51, *Pertorcus* sp.; 52-53, *Zygobaris nitens*. 52, prosternum (photograph); 53, prosternum (illustration); 54, *Xystus ruficollis*, prosternum (mesosternal process).

Figs. 55-59. Prosterna (mesosternal process). 55, *Limnobaris calandriformis*; 56, *Loboderes citriventris*; 57, *Madopterus talpa*; 58, *Parallelosomus amplitarsis*; 59, *Peridinetus cretaceus*.

Figs. 60-64. 60, *Zygobarella zanthoxyli*, sclerolepidia (SEM); 61, *Lydamis cinnamomeus*, sclerolepidia (SEM). 62-64, mesoscutellum. 62, *Pertorcus* sp.; 63, *Pycnogeraeus striatirostris*; 64, *Pachybaris porosa*.

Figs. 65-73. 65, *Pycnogeraeus ochraceus*, mesonotum; 66, *Garnia* sp., mesonotum; 67-68, generalized types of prescuta. 69-73, metanotum. 69, *Leptoschoinus fucatus*; 70, *Garnia* sp.; 71, *Centrinus curvirostris*; 72, *Peridinetus irroratus*; 73, *Camelodes leachii*.

Figs. 74-77. 74, *Madopterus talpa*, metanotum; 75-77, metendosternite. 75, *Leptoschoinus fucatus*; 76, *Pardisomus biplagiatus*; 77, *Madopterus talpa*.

Figs. 78-82. 78, *Madarus bistrigellus*, apical tibial uncus; 79, *Demoda vittata*, apical tibial uncus; 80, *Zygobarella zanthoxyli*, connate pre-tarsal ungues; 81, *Anthinobaris* sp., connate pre-tarsal ungues; 82, *Baris* sp., diverging pre-tarsal ungues.

Figs. 83-86. 83, generalized baridine hind wing venation. 84-86, hind wings. 84, *Cryptorhynchus lapathi* (Cryptorhynchinae); 85, *Cholus rana* (Molytinae); 86, *Cylindrocopturus adspersus* (Conoderinae).

Figs. 87-89. 87-88, elytra. 87, *Odontocorynus creperus*; 88, *Coleomerus boliviensis*; 89, *Idiostethus tubulatus*, ventrites.

Figs. 90-94. 90-91, *Acythopeus* sp. 90, tergites and spiculate patches; 91, enlargement of tergites 4-7; 92, *Pycnogeraeus modestus*, tergite 7; 93, *Deipyrus hirsutulus*, plectra on tergite 7; 94, *Diastethus eurthinoides*, plectra on tergite 7.

Figs. 95-102. 95-98, tergites. 95, *Centrinus curvirostris*; 96, *Peridinetus irroratus*; 97, *Xystus ruficollis*; 98, *Calandrinus grandicollis*. 99-102, female genitalia. 99, *Limnobaris* sp., spermatheca and sternite 8; 100, *Strongylotes squamans*, spermatheca; 101, *Parasomenes curvirostris*, sternite 8; 102, *Zena* sp., spermatheca and sternite 8.

Figs. 103-109. Male genitalia. 103-108, aedeagus. 103, *Stethobaroides nudiventris*; 104, *Barilepton filiforme*; 105, *Garnia* sp.; 106, *Pardisomus biplagiatus*; 107, *Solenosternus dividuus*; 108, *Pteracanthus smidtii*; 109, *Stereobaris interpunctata*.

Fig. 110. Strict consensus tree of length 4,850 steps (of 33 most-parsimonious trees of length 4,509 steps) produced in TNT, with old classification, including tribes and subtribes, indicated.

Fig. 110 (continued). Strict consensus tree of length 4,850 steps (of 33 most-parsimonious trees of length 4,509 steps) produced in TNT, with old classification, including tribes and subtribes, indicated.

Fig. 111. Strict consensus tree with suggested revised classification. Numbers above nodes indicate jackknife values, numbers below nodes indicate bremer values (absolute bremer/relative bremer).

Fig. 112. Strict consensus tree with characters (below branches) and character states (above branches) mapped onto branches using WinClada's fast optimization (ACCTRAN).

Fig. 112 (continued). Strict consensus tree with characters (below branches) and character states (above branches) mapped onto branches using WinClada's fast optimization (ACCTRAN).

Fig. 112 (continued). Strict consensus tree with characters (below branches) and character states (above branches) mapped onto branches using WinClada's fast optimization (ACCTRAN).

Fig. 112 (continued). Strict consensus tree with characters (below branches) and character states (above branches) mapped onto branches using WinClada's fast optimization (ACCTRAN).

Fig. 112 (continued). Strict consensus tree with characters (below branches) and character states (above branches) mapped onto branches using WinClada's fast optimization (ACCTRAN).

Fig. 112 (continued). Strict consensus tree with characters (below branches) and character states (above branches) mapped onto branches using WinClada's fast optimization (ACCTRAN).

Fig. 113. Strict consensus tree with characters (below branches) and character states (above branches) mapped onto branches using WinClada's slow optimization (DELTRAN).

Fig. 113 (continued). Strict consensus tree with characters (below branches) and character states (above branches) mapped onto branches using WinClada's slow optimization (DELTRAN).

Fig. 113 (continued). Strict consensus tree with characters (below branches) and character states (above branches) mapped onto branches using WinClada's slow optimization (DELTRAN).

Fig. 113 (continued). Strict consensus tree with characters (below branches) and character states (above branches) mapped onto branches using WinClada's slow optimization (DELTRAN).

Fig. 113 (continued). Strict consensus tree with characters (below branches) and character states (above branches) mapped onto branches using WinClada's slow optimization (DELTRAN).

Fig. 113 (continued). Strict consensus tree with characters (below branches) and character states (above branches) mapped onto branches using WinClada's slow optimization (DELTRAN).

Fig. 114. Strict consensus tree with characters (below branches) and character states (above branches) mapped onto branches using WinClada and showing unambiguous changes only (no optimization).

Fig. 114 (continued). Strict consensus tree with characters (below branches) and character states (above branches) mapped onto branches using WinClada and showing unambiguous changes only (no optimization).

Fig. 114 (continued). Strict consensus tree with characters (below branches) and character states (above branches) mapped onto branches using WinClada and showing unambiguous changes only (no optimization).

Fig. 114 (continued). Strict consensus tree with characters (below branches) and character states (above branches) mapped onto branches using WinClada and showing unambiguous changes only (no optimization).

Fig. 114 (continued). Strict consensus tree with characters (below branches) and character states (above branches) mapped onto branches using WinClada and showing unambiguous changes only (no optimization).

Fig. 114 (continued). Strict consensus tree with characters (below branches) and character states (above branches) mapped onto branches using WinClada and showing unambiguous changes only (no optimization).

Fig. 115. 1 of 110 most-parsimonious trees produced from the reduced taxon matrix (RTM) of length 2,692 produced in TNT, with old classification, including tribes and subtribes, indicated.

Fig. 116. Strict consensus tree of length (of 110 most-parsimonious trees of length 2,692) produced from the RTM. Numbers above nodes indicate jackknife values, numbers below nodes indicate bremer values (absolute bremer/relative bremer).

Fig. 117. 1 of 110 most-parsimonious trees produced from the RTM with suggested revised classification.

Fig. 118. 1 of 110 most-parsimonious trees produced from the RTM with characters (below branches) and character states (above branches) mapped onto branches using WinClada's fast optimization (ACCTRAN).

Fig. 118 (continued). 1 of 110 most-parsimonious trees produced from the RTM with characters (below branches) and character states (above branches) mapped onto branches using WinClada's fast optimization (ACCTRAN).

Fig. 118 (continued). 1 of 110 most-parsimonious trees produced from the RTM with characters (below branches) and character states (above branches) mapped onto branches using WinClada's fast optimization (ACCTRAN).

Fig. 118 (continued). 1 of 110 most-parsimonious trees produced from the RTM with characters (below branches) and character states (above branches) mapped onto branches using WinClada's fast optimization (ACCTRAN).

Fig. 119. 1 of 110 most-parsimonious trees produced from the RTM with characters (below branches) and character states (above branches) mapped onto branches using WinClada's slow optimization (DELTRAN).

Fig. 119 (continued). 1 of 110 most-parsimonious trees produced from the RTM with characters (below branches) and character states (above branches) mapped onto branches using WinClada's slow optimization (DELTRAN).

Fig. 119 (continued). 1 of 110 most-parsimonious trees produced from the RTM with characters (below branches) and character states (above branches) mapped onto branches using WinClada's slow optimization (DELTRAN).

Fig. 119 (continued). 1 of 110 most-parsimonious trees produced from the RTM with characters (below branches) and character states (above branches) mapped onto branches using WinClada's slow optimization (DELTRAN).

Fig. 120. 1 of 110 most-parsimonious trees produced from the RTM with characters (below branches) and character states (above branches) mapped onto branches using WinClada and showing unambiguous changes only (no optimization).

Fig. 120 (continued). 1 of 110 most-parsimonious trees produced from the RTM with characters (below branches) and character states (above branches) mapped onto branches using WinClada and showing unambiguous changes only (no optimization).

Fig. 120 (continued). 1 of 110 most-parsimonious trees produced from the RTM with characters (below branches) and character states (above branches) mapped onto branches using WinClada and showing unambiguous changes only (no optimization).

Fig. 120 (continued). 1 of 110 most-parsimonious trees produced from the RTM with characters (below branches) and character states (above branches) mapped onto branches using WinClada and showing unambiguous changes only (no optimization).

Fig. 121. Character 88 (sclerotization of tergites) mapped onto strict consensus tree.

Fig. 122. Character 46 (posterior margin of mesonotum), supporting monophyly of Baridinae, mapped onto strict consensus tree.

Fig. 123. Character 54 (lateral margin of postnotum), supporting monophyly of Baridinae, mapped onto strict consensus tree.

Fig. 124. Character 98 (abdominal lateral tergite), supporting monophyly of Baridinae, mapped onto strict consensus tree.

Fig. 125. Character 41 (mesepimeron), supporting monophyly of Baridinae, mapped onto strict consensus tree.

Fig. 126. Biogeographic regions mapped onto strict consensus tree.

Fig. 126 (continued). Biogeographic regions mapped onto strict consensus tree.

Fig. 127. Known host plant groups mapped onto strict consensus tree.

Fig. 127 (continued). Known host plant groups mapped onto strict consensus tree.

Fig. 128. Most parsimonious tree obtained through analysis of full dataset using implied weights in TNT; k=2; implied weights best score=92.57134; L=5287 steps, Ci=4, Ri=43.

Fig. 129. Most parsimonious tree obtained through analysis of full dataset using implied weights in TNT; k=4; implied weights best score=86.71261; L=5224 steps, Ci=4, Ri=43.

Fig. 130. Most parsimonious tree obtained through analysis of full dataset using implied weights in TNT; k=6; implied weights best score=82.15793; L=5192 steps, Ci=4, Ri=44.

Fig. 131. Most parsimonious tree obtained through analysis of full dataset using implied weights in TNT; k=8; implied weights best score=78.30540; L=5130 steps, Ci=4, Ri=44.

Fig. 132. Most parsimonious tree obtained through analysis of RTM using implied weights in TNT; k=2; implied weights best score=89.40104; L=3041 steps, Ci=7, Ri=43.

Fig. 133. Most parsimonious tree obtained through analysis of RTM using implied weights in TNT; k=4; implied weights best score=81.77424; L=3022 steps, Ci=7, Ri=43.

Fig. 134. Most parsimonious tree obtained through analysis of RTM using implied weights in TNT; k=6; implied weights best score=75.89121; L=2949 steps, Ci=7, Ri=44.

Fig. 135. Most parsimonious tree obtained through analysis of RTM using implied weights in TNT; k=8; implied weights best score=70.88550; L=2916 steps, Ci=7, Ri=45.

Fig. 136. Phylogeny produced by bayesian analysis, with 3 million generations, using full dataset. Values at nodes represent bayesian posterior probabilities.

Fig. 136 (continued). Phylogeny produced by bayesian analysis, with 3 million generations, using full dataset. Values at nodes represent bayesian posterior probabilities.

Fig. 137. Phylogeny produced by bayesian analysis, with 10 million generations, using full dataset. Values at nodes represent bayesian posterior probabilities.

Fig. 137 (continued). Phylogeny produced by bayesian analysis, with 10 million generations, using full dataset. Values at nodes represent bayesian posterior probabilities.

Fig. 138. Phylogeny produced by bayesian analysis, with 3 million generations, using RTM. Values at nodes represent bayesian posterior probabilities.

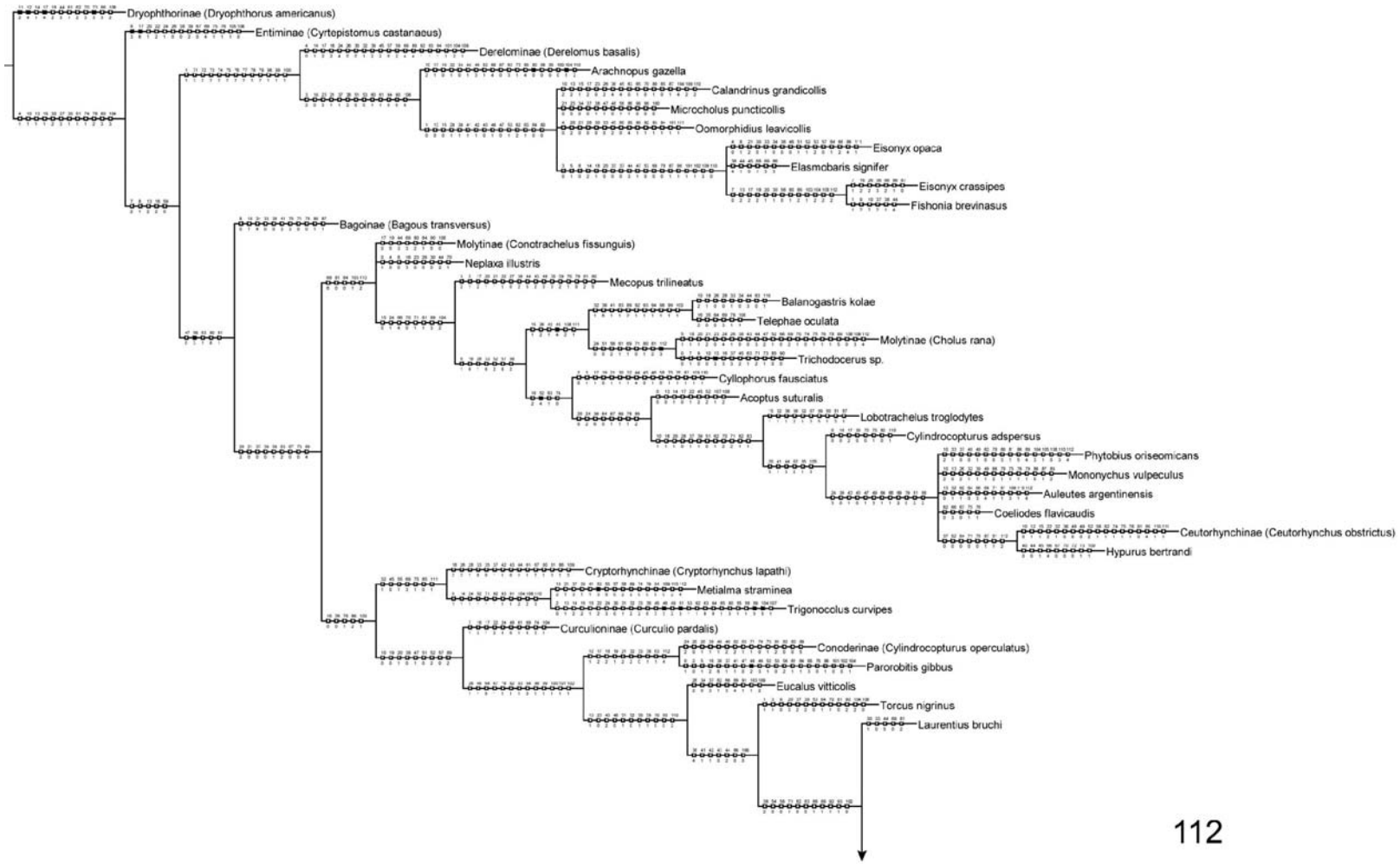
Fig. 139. Phylogeny produced by bayesian analysis, with 10 million generations, using RTM. Values at nodes represent bayesian posterior probabilities.

Figs. 140-144. Histograms for the bayesian analysis of the full dataset with 3 million generations. 140, frequency plotted against tree log likelihood; 141, frequency plotted against tree length; 142, log likelihood plotted against generation time; 143, tree length plotted against generation time; 144, tree length plotted against log likelihood.

Figs. 145-149. Histograms for the bayesian analysis of the full dataset with 10 million generations. 145, frequency plotted against tree log likelihood; 146, frequency plotted against tree length; 147, log likelihood plotted against generation time; 148, tree length plotted against generation time; 149, tree length plotted against log likelihood.

Figs. 150-154. Histograms for the bayesian analysis of the RTM with 3 million generations. 150, frequency plotted against tree log likelihood; 151, frequency plotted against tree length; 152, log likelihood plotted against generation time; 153, tree length plotted against generation time; 154, tree length plotted against log likelihood.

Figs. 155-159. Histograms for the bayesian analysis of the RTM with 10 million generations. 155, frequency plotted against tree log likelihood; 156, frequency plotted against tree length; 157, log likelihood plotted against generation time; 158, tree length plotted against generation time; 159, tree length plotted against log likelihood.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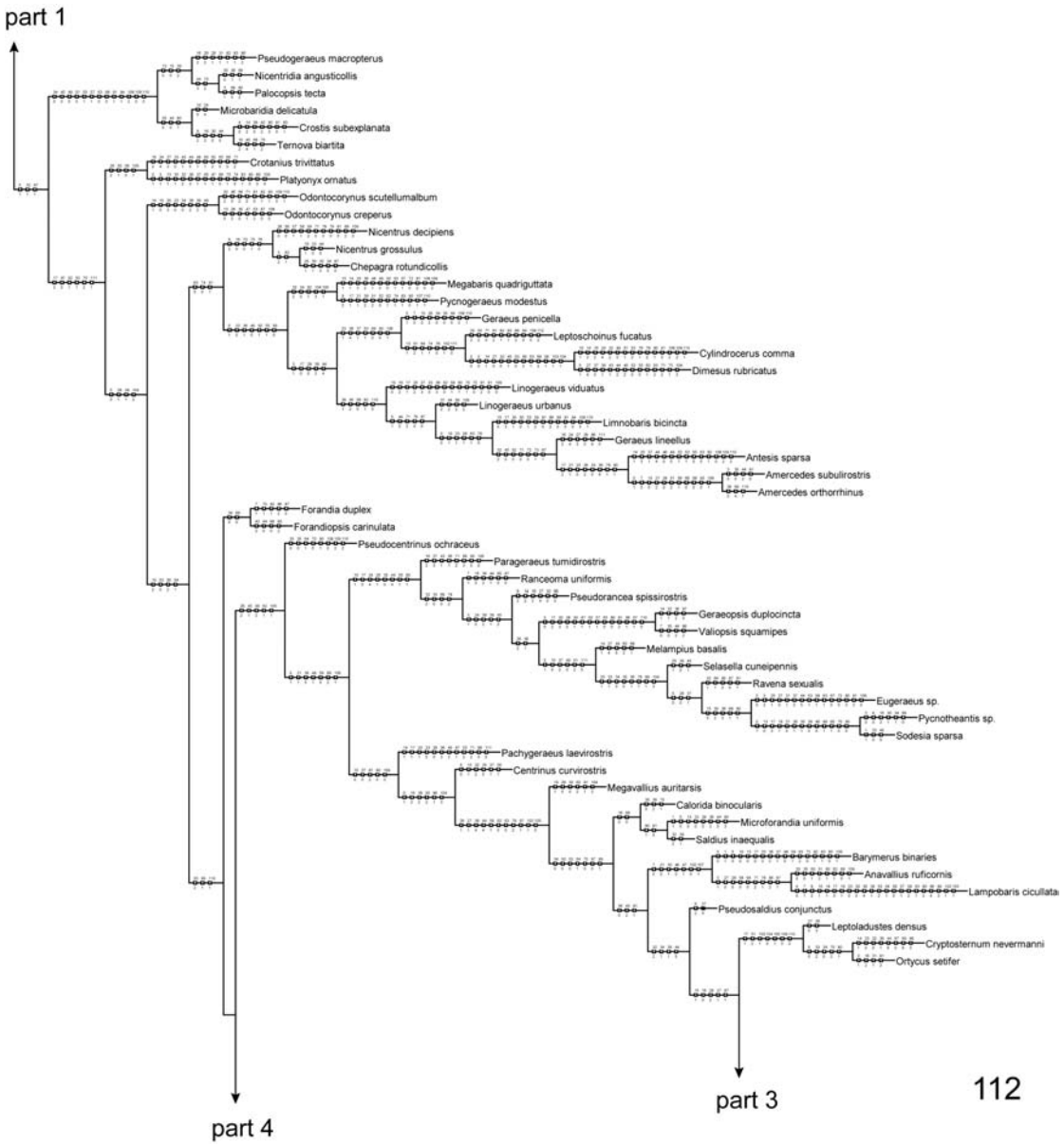
Entiminae (Cyrtepistomus castaneaus)
Dereleminae (Derelomus basalis)
Arachnopus gazella
Calandrinus grandicollis
Microcholus puncticollis
Oomorphidius leavicollis
Eisonyx opaca
Elasmocbaris signifer
Eisonyx crassipes
Fishonia brevinasus
Bagoinae (Bagous transversus)
Molytinae (Conotrachelus fissunguis)
Neplaxa illustris
Mecopus trilineatus
Balanogastris kolae
Telephae oculata
Molytinae (Cholus rana)
Trichodocerus sp.
Cyllophorus fausciatus
Acoptus suturalis
Lobotrachelus troglodytes
Cylindrocopturus adspersus
Phytobius oriseomicans
Mononychus vulpeculus
Auleutes argentinensis
Coeliodes flavicaudis
Ceutorhynchinae (Ceutorhynchus obstrictus)
Hypurus bertrandi
Cryptorhynchinae (Cryptorhynchus lapathi)
Metialma straminea
Trigonocclus curvipes
Curculioninae (Curculio pardalis)
Conoderinae (Cylindrocopturus operculatus)
Parorobitis gibbus
Eucalus vitticolis
Torcus nigrinus
Laurentius bruchi

part 2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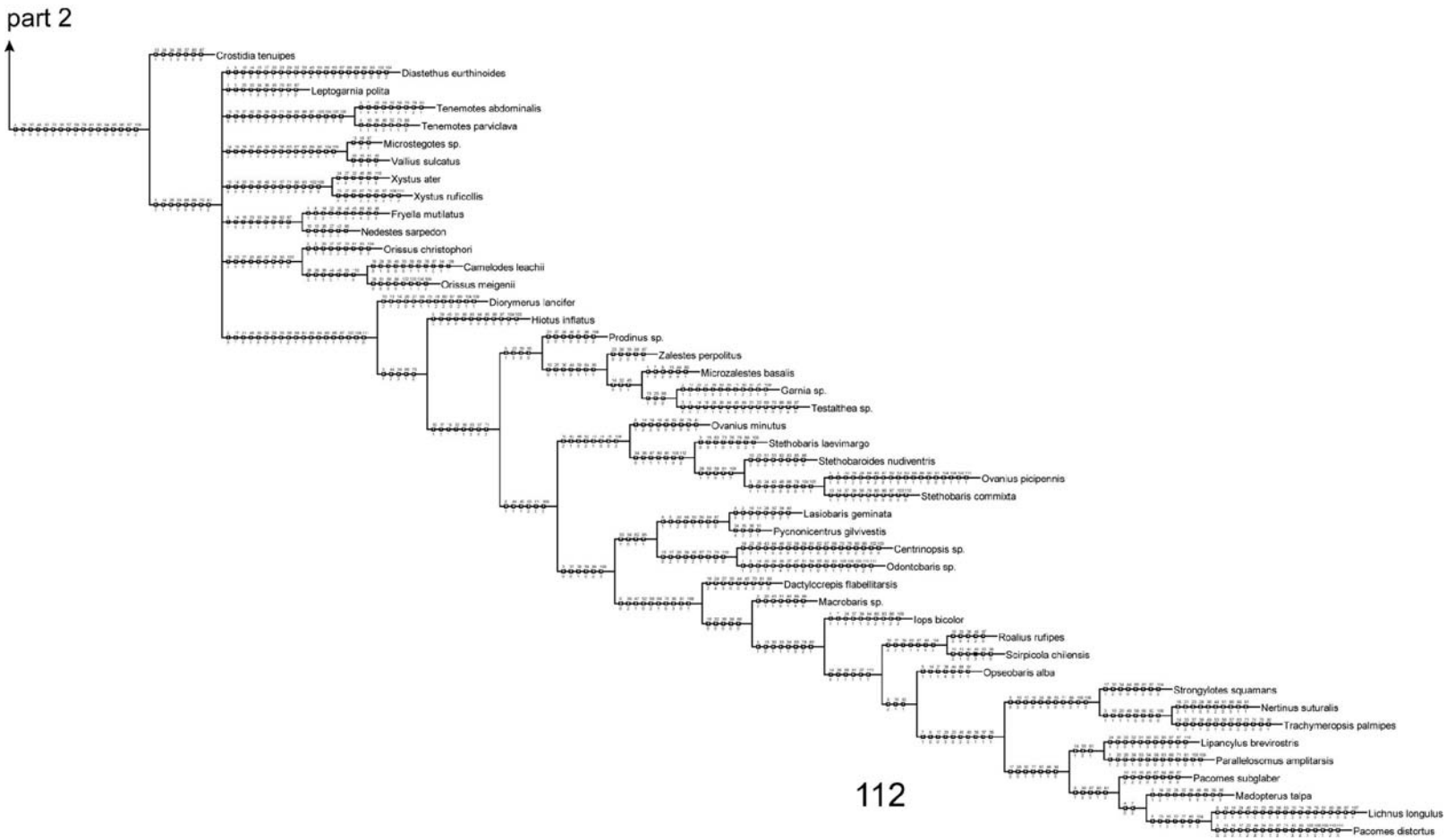
Palocopsis tecta
Microbaridia delicatula
Crostis subexplanata
Ternova biartita
Crotanius trivittatus
Platyonyx ornatus
Odontocorynus scutellumalbum
Odontocorynus creperus
Nicentrus decipiens
Nicentrus grossulus
Chepagra rotundicollis
Megabaris quadriguttata
Pycnogeraeus modestus
Geraeus penicella
Leptoschoinus fucatus
Cylindrocerus comma
Dimesus rubricatus
Linogeraeus viduatus
Linogeraeus urbanus
Limnobaris bicincta
Geraeus lineellus
Antesis sparsa
Amercedes subulirostris
Amercedes orthorrhinus
Forandia duplex
Forandiopsis carinulata
Pseudocentrinus ochraceus
Parageraeus tumidirostris
Ranceoma uniformis
Pseudorancea spissirostris
Geraeopsis duplocincta
Valiopsis squamipes
Melampius basalis
Selasella cuneipennis
Ravena sexualis
Eugeraeus sp.
Pycnotheantis sp.
Sodesia sparsa
Pachygeraeus laevirostris
Centrinus curvirostris
Megavallius auritarsis
Calorida binocularis
Microforandia uniformis
Saldius inaequalis
Barymerus binaries
Anavallius ruficornis
Lampobaris cicullata
Pseudosaldius conjunctus
Leptoladustes densus
Cryptosternum nevermanni
Ortycus setifer
part 3
part 4
112


part 2
Crostidia tenuipes
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Leptogarnia polita
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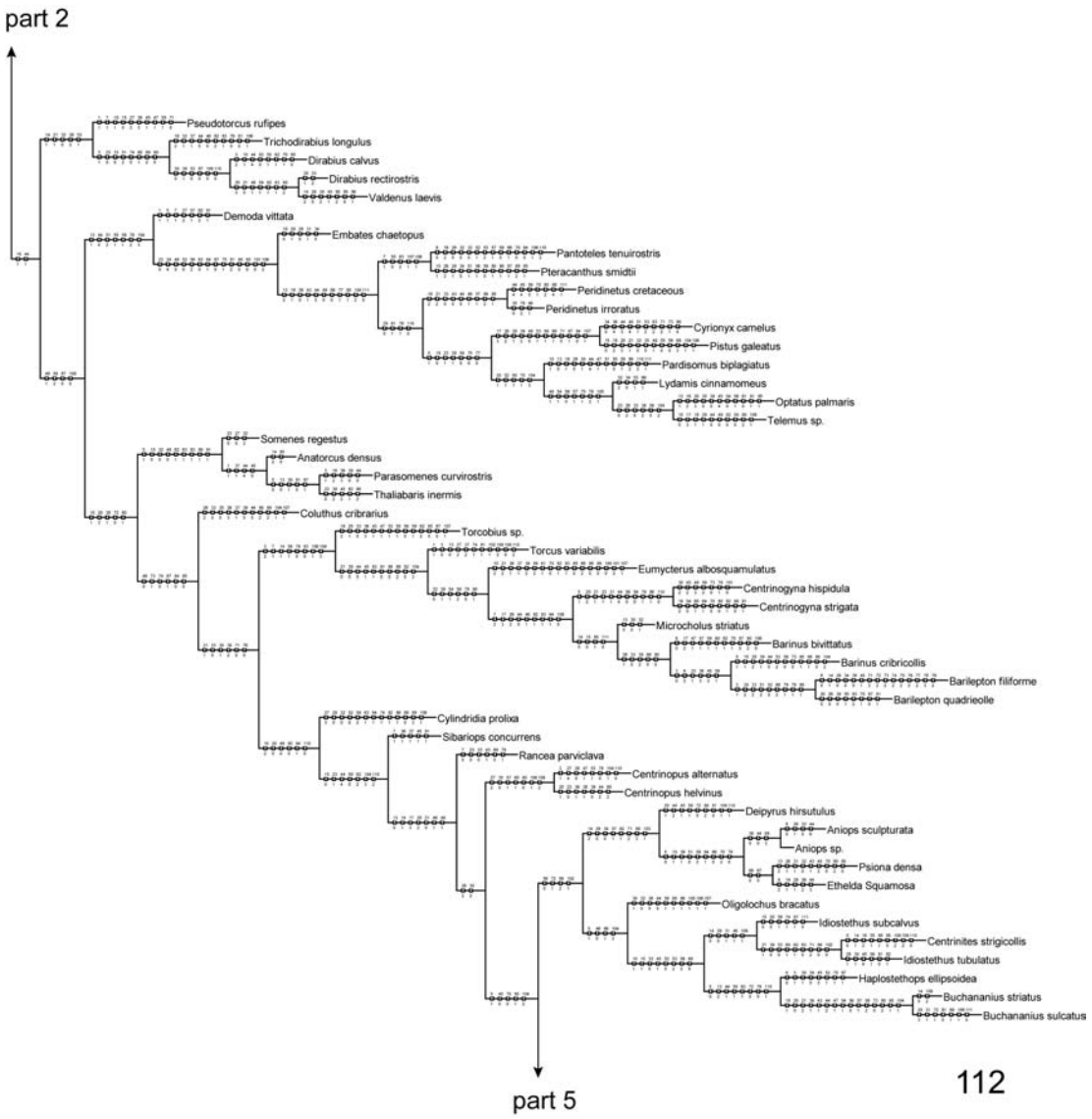
Tenemotes parviclava
Microstegotes sp.
Vallius sulcatus
Xystus ater
Xystus ruficollis
Fryella mutilatus
Nedestes sarpedon
Orissus christophori
Camelodes leachii
Orissus meiganii
Diorymerus lancifer
Hiotus inflatus
Prodinus sp.
Zalestes perpolitus
Microzalestes basalis
Garnia sp.
Testalthea sp.
Ovanius minutus
Stethobaris laevimargo
Stethobaroides nudiventris
Ovanius picipennis
Stethobaris commixta
Lasiobaris geminata
Pycnonicentrus silvivestis
Centrinopsis sp.
Odontobaris sp.
Dactylccrepis flabellitarsis
Macrobaris sp.
Iops bicolor
Roalius rufipes
Scirpicola chilensis
Opseobaris alba
Strongylotes squamans
Nertinus suturalis
Trachymeropsis palmipes
Lipancylus brevirostris
Parallelosomus amplitarsis
Pacomes subglaber
Madopterus talpa
Lichnus longulus
Pacomes distortus
112


part 2
Pseudotorcus rufipes
Trichodirabius longulus
Dirabius calvus
Dirabius rectirostris
Valdenus laevis
Demoda vittata
Embates chaetopus
Pantoteles tenuirostris
Pteracanthus smidtii
Peridinetus cretaceous
Peridinetus irroratus
Cyrionyx carnelus
Pistus galeatus
Pardisomus biplagiatus
Lydamis cinnamomeus
Optatus palmaris
Telemus sp.
Somenes regestus
Anatorcus densus
Parasomenes curvirostris
Thaliabaris inermis
Coluthus cribrarius
Torcobius sp.
Torcus variabilis
Eumycterus albosquamulatus
Centrinogyna hispidula
Centrinogyna strigata
Microcholus striatus
Barinus bivittatus
Barinus cribricollis
Barilepton filiforme
Barilepton quadrieolle
Cylindridia prolixa
Sibariops concurrens
Rancea parviclava
Centrinopus alternatus
Centrinopus helvinus
Deipyrus hirsutulus
Aniops sculpturata
Aniops sp.
Psiona densa
Ethelda Squamosa
Oligolochus bracatus
Idiostethus subcalvus
Centrinites strigicollis
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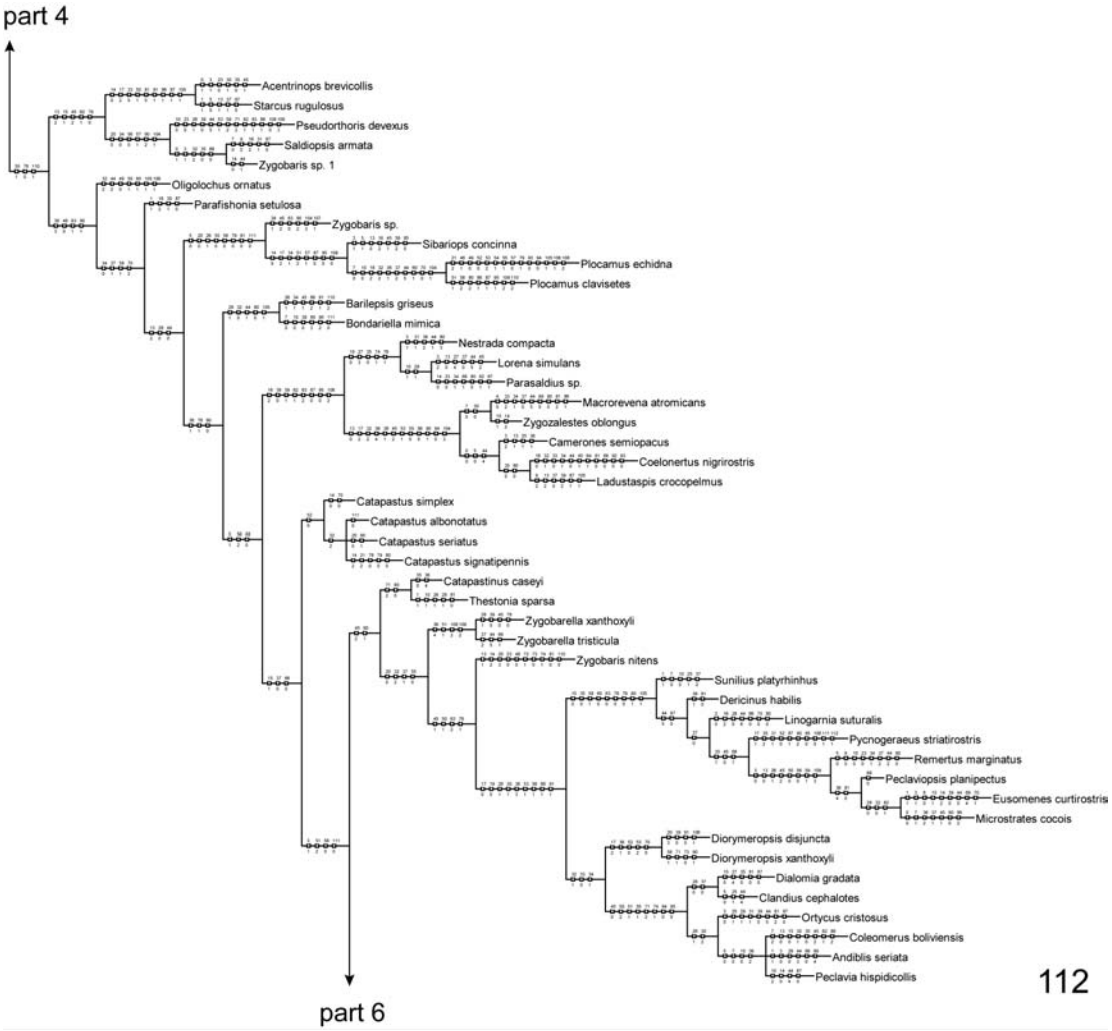
Haplostethops ellipsoidea
Buchananius striatus
Buchananius sulcatus
part 5
112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Saldiopsis armata
Zygobaris sp. 1
Oligolochus ornatus
Parafishonia setulosa
Zygobaris sp.
Sibariops concinna
Plocamus echidna
Plocamus clavisetes
Barilepsis griseus
Bondariella mimica
Nestrada compacta
Lorena simulans
Parasaldius sp.
Macrorevena atromicans
Zygozalestes oblongus
Camerones semiopacus
Coelonertus nigrirostris
Ladustaspis crocopelmus
Catapastus simplex
Catapastus albonotatus
Catapastus seriatus
Catapastus signatipennis
Catapastinus caseyi
Thestonia sparsa
Zygobarella xanthoxyli
Zygobarella tristicula
Zygobaris nitens
Sunilius platyrhinhus
Dericinus habilis
Linogarnia suturalis
Pycnogeraeus striatirostris
Remertus marginatus
Peclaviopsis planipectus
Eusomenes curtirostris
Microstrates cocois
Diorymeropsis disjuncta
Diorymeropsis xanthoxyli
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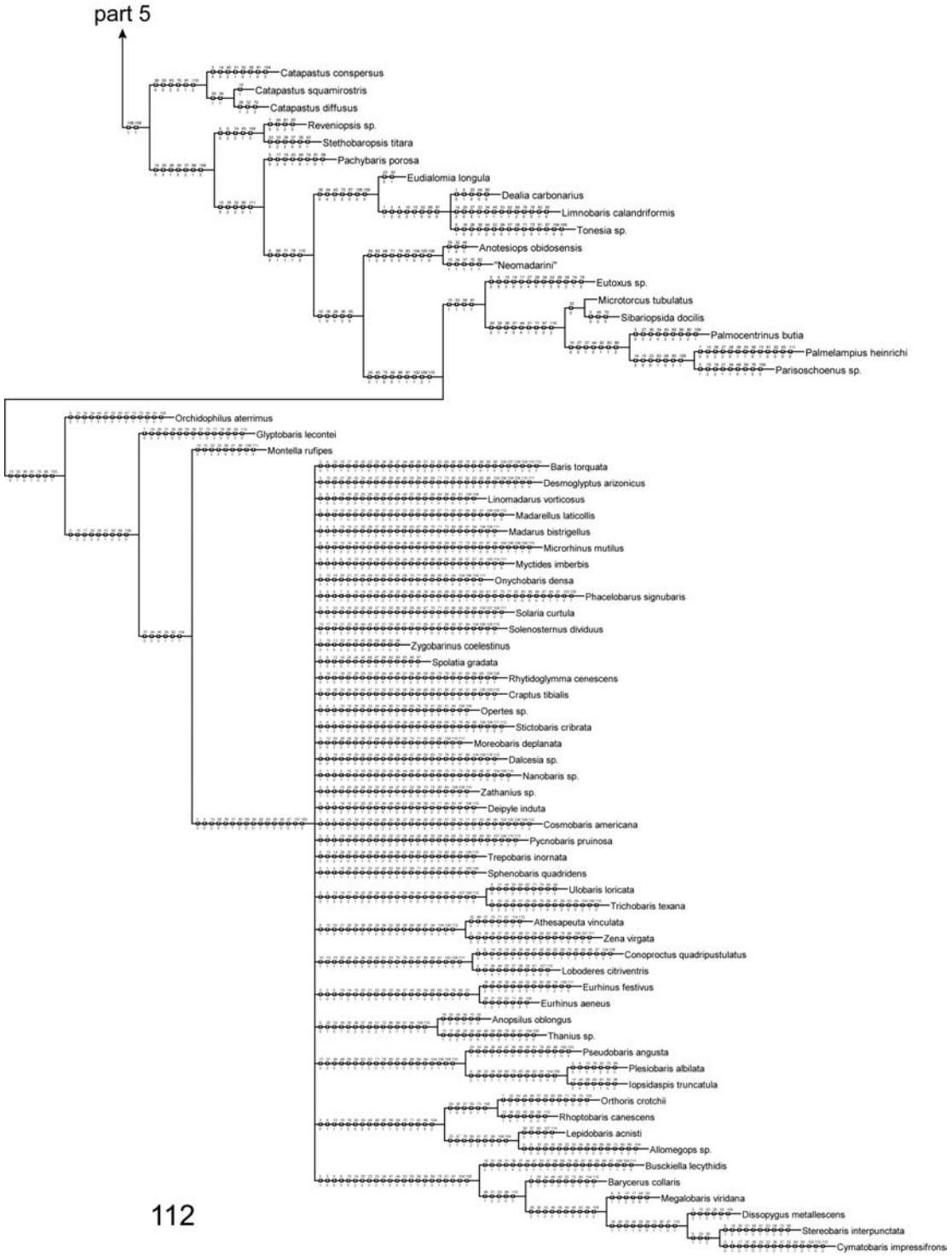
Clandius cephalotes
Ortycus cristosus
Coleomerus boliviensis
Andiblis seriata
Peclavia hispidicollis
112
part 6


part 5
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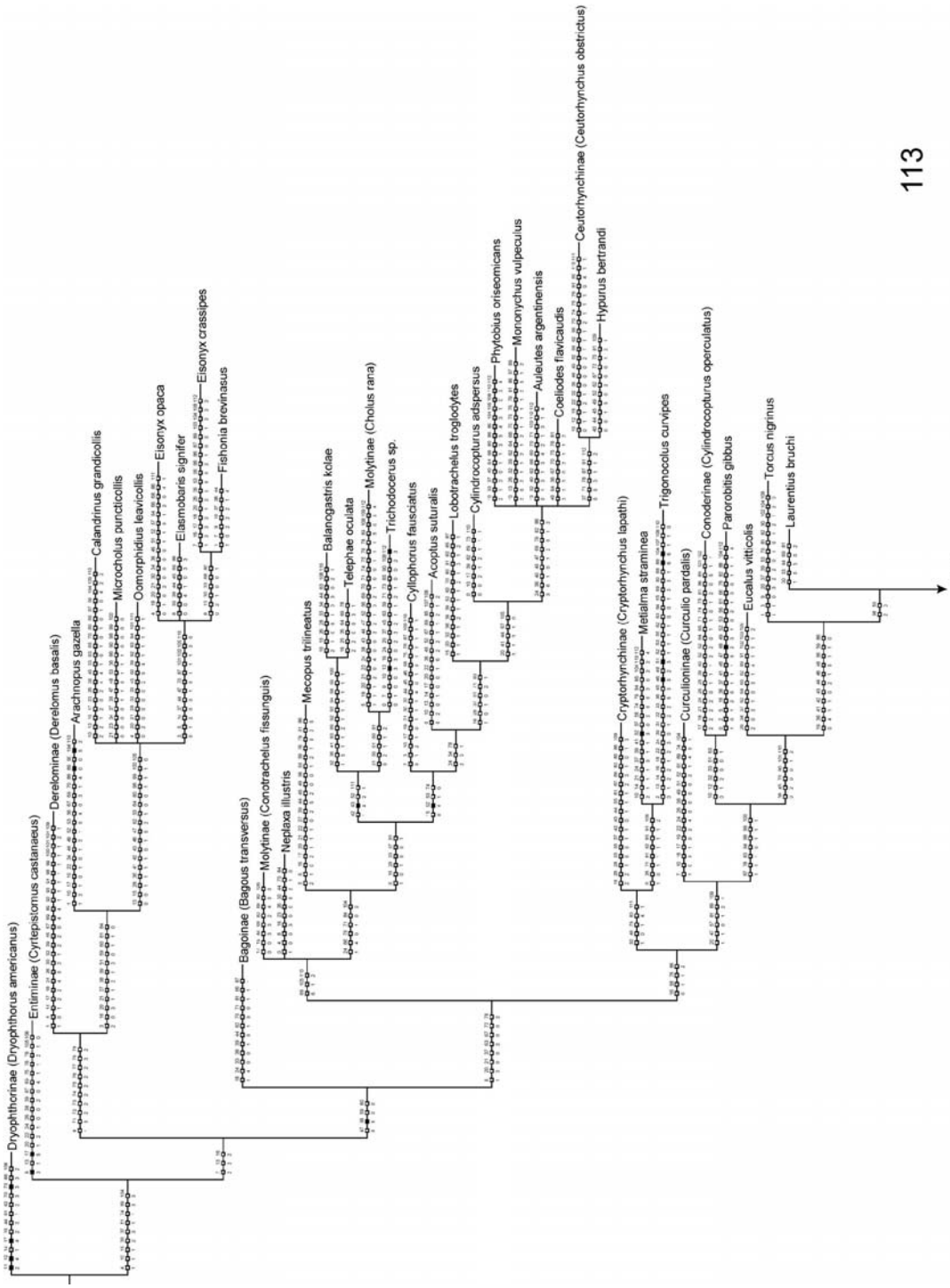
Catapastus diffusus
Reveniopsis sp.
Stethobaropsis titara
Pachybaris porosa
Eudialomia longula
Dealia carbonarius
Limnobaris calandriformis
Tonesia sp.
Anotesiops obidosensis
"Neomadarini"
Eutoxus sp.
Microtorcus tubulatus
Sibariopsida docilis
Palmocentrinus butia
Palmelampius heinrichi
Parisoschoenus sp.
Orchidophilus aterrimus
Glyptobaris lecontei
Montella rufipes
Baris torquata
Desmoglyptus arizonicus
Linomadarus vorticosus
Madarellus laticollis
Madarus bistrigellus
Microrhinus mutilus
Myctides imberbis
Onychobaris densa
Phacelobarus signubaris
Solaria curtula
Solenosternus dividuus
Zygobarinus coelestinus
Spolatia gradata
Rhytidoglymma cenescens
Craptus tibialis
Opertes sp.
Stictobaris cribrata
Moreobaris deplanata
Dalcesia sp.
Nanobaris sp.
Zathanius sp.
Deipyle induta
Cosmobaris americana
Pycnobaris pruinosa
Trepobaris inornata
Sphenobaris quadridens
Ulobaris loricata
Trichobaris texana
Athesapeuta vinculata
Zena virgata
Conoproctus quadripustulatus
Loboderes citriventris
Eurhinus festivus
Eurhinus aeneus
Anopsilus oblongus
Thanius sp.
Pseudobaris angusta
Plesiobaris albilata
Iopsidaspis truncatula
Orthoris crotchii
Rhoptobaris canescens
Lepidobaris acnisti
Allomegops sp.
Busckiella lecythidis
Barycerus collaris
Megalobaris viridana
Dissopygus metallescens
Stereobaris interpunctata
Cymatobaris impressifrons
112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Derelominae (Derelomus basalis)
Arachnopus gazella
Calandrinus grandicollis
Microcholus punctilollis
Oomorphidius leavicollis
Elsonyx opaca
Elasmobaris signifer
Elsonyx crassipes
Fiehonia brevinasus
Bagoinae (Bagous transversus)
Molytinae (Conotrachelus fissunguis)
Neplaxa illustris
Mecopus triineatus
Balanogastris kolae
Telephae oculata
Molytinae (Cholus rana)
Trichodocerus sp.
Cyllophorus fausciatus
Acoptus suturalis
Lobotrachelus troglodytes
Cylindrocopturus adspersus
Phytobius oriseomicans
Monorychus vulpeculus
Auleutes argentinensis
Coeliodes flavicaudis
Ceutorhynchinae (Ceutorhynchus obstrictus)
Hypurus bertrandi
Cryptorhynchinae (Cryptorhynchus lapathi)
Metialma straminea
Trigonocolus curvipes
Curculioninae (Curculio pardalis)
Conoderinae (Cylindrocopturus operculatus)
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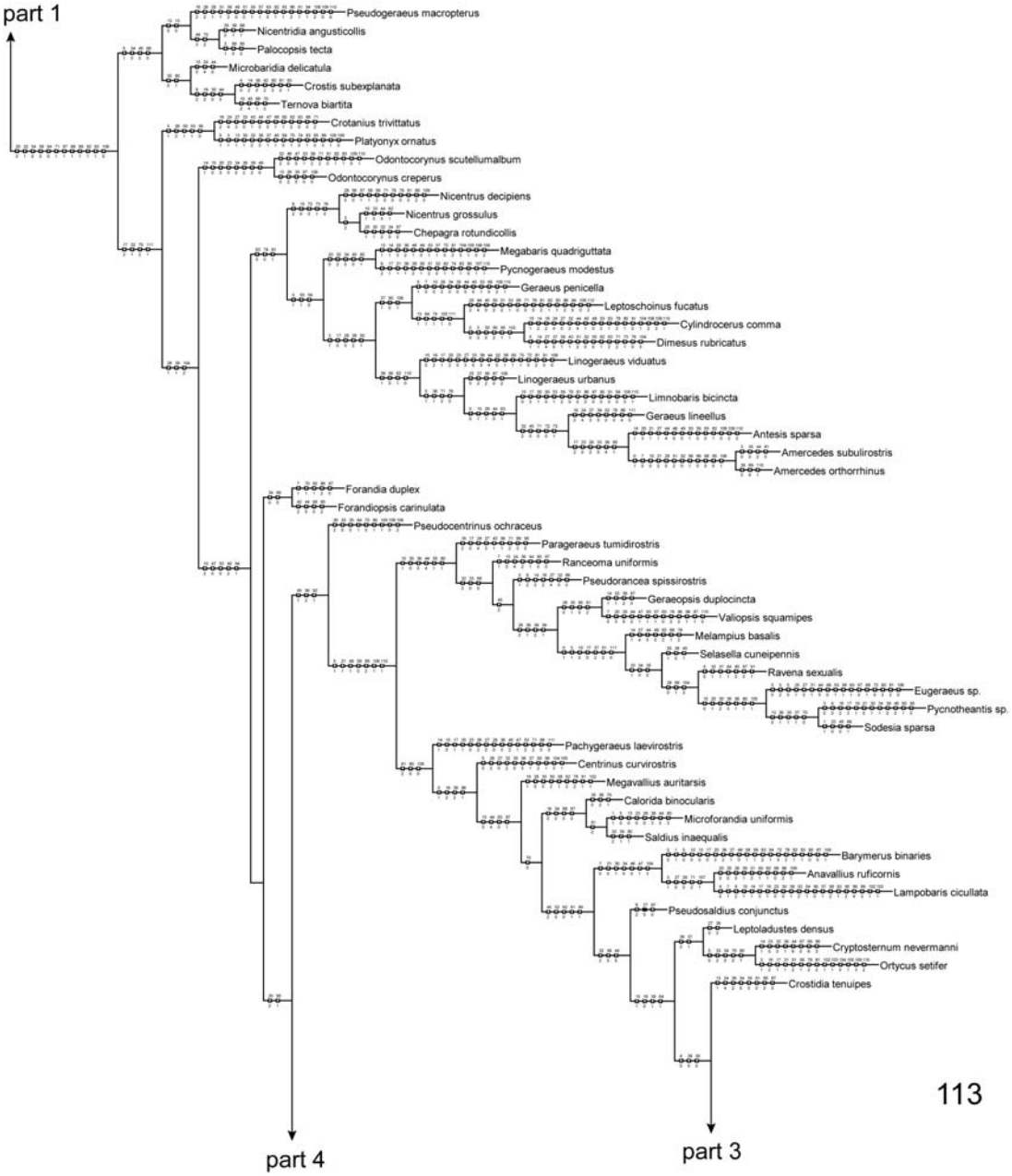
Eucalus vitticollis
Torcus nigrinus
Laurentius bruchi
113
part 2


part 1
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Palocopsis tecta
Microbaridia delicatula
Crostis subexplanata
Ternova biartita
Crotanius trivittatus
Platyonyx ornatus
Odontocorynus scutellumalbum
Odontocorynus creperus
Nicentrus decipiens
Nicentrus grossulus
Chepagra rotundicollis
Megabaris quadriguttata
Pycnogeraeus modestus
Geraeus penicella
Leptoschoinus fucatus
Cylindrocerus comma
Dimesus rubricatus
Linogeraeus viduatus
Linogeraeus urbanus
Limnobaris bicincta
Geraeus lineellus
Antesis sparsa
Amercedes subulirostris
Amercedes orthorrhinus
Forandia duplex
Forandiopsis carinulata
Pseudocentrinus ochraceus
Parageraeus tumidirostris
Ranceoma uniformis
Pseudorancea spissirostris
Geraeopsis duplocincta
Valiopsis squamipes
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Eugeraeus sp.
Pycnotheantis sp.
Sodesia sparsa
Pachygeraeus laevirostris
Centrinus curvirostris
Megavallius auritarsis
Calorida binocularis
Microforandia uniformis
Saldius inaequalis
Barymerus binaries
Anavallius ruficornis
Lampobaris cicullata
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Ortycus setifer
Crostidia tenuipes
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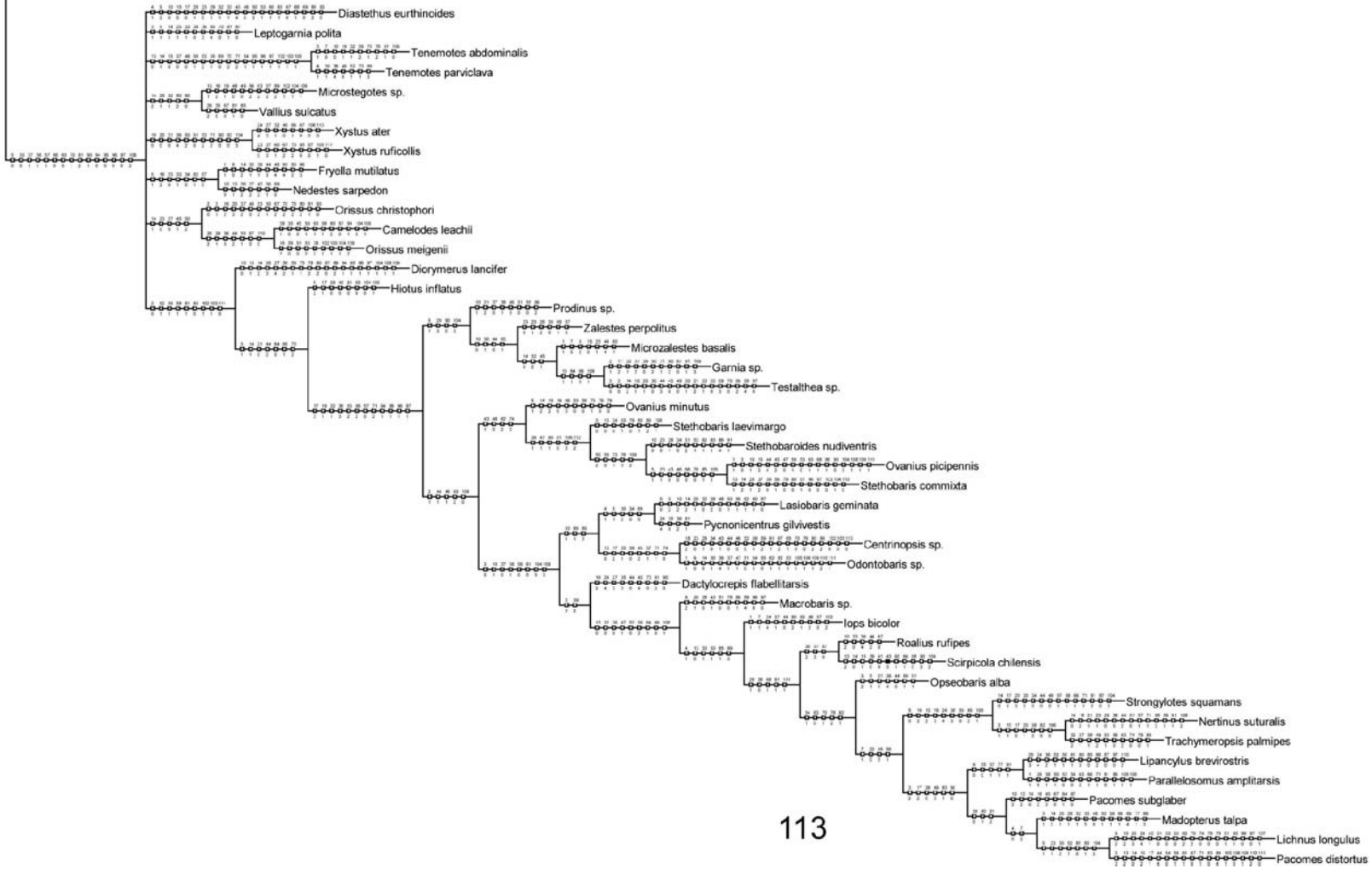
part 4
part 3

part 2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Leptogarnia polita
Tenemotes abdominalis
Tenemotes parviclava
Microstegotes sp.
Vallius suicatus
Xystus ater
Xystus ruficollis
Fryella mutilatus
Nedestes sarpedon
Orissus christophori
Camelodes leachii
Orissus meigenii
Diorymerus lancifer
Hiotus inflatus
Prodinus sp.
Zalestes perpolitus
Microzalestes basalis
Garnia sp.
Testalthea sp.
Ovanius minutus
Stethobaris laevimargo
Stethobaroides nudiventris
Ovanius picipennis
Stethobaris commixta
Lasiobaris geminata
Pycnonicentrus gilvivestis
Centrinopsis sp.
Odontobaris sp.
Dactylocrepis flabellitarsis
Macrobaris sp.
Iops bicolor
Roalius rufipes
Scirpicola chilensis
Opseobaris alba
Strongylotes squamans
Nertinus suturalis
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Lipancylus brevirostris
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Pacomes subglaber
Madopterus talpa
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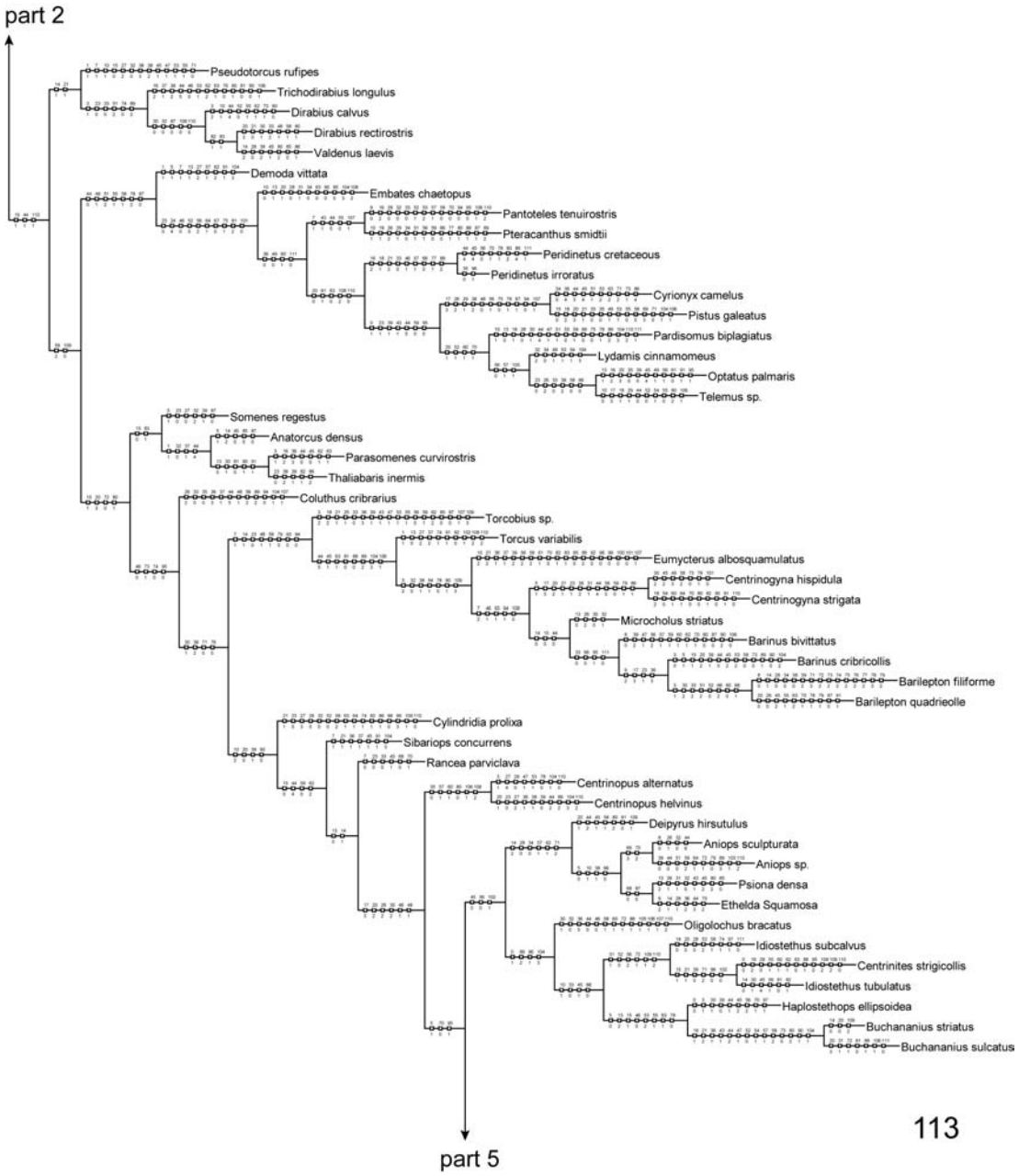
Pacomes distortus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Dirabius calvus
Dirabius rectirostris
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Demoda vittata
Embates chaetopus
Pantoteles tenuirostris
Pteracanthus smidtii
Peridinetus cretaceous
Peridinetus irroratus
Cyrionyx camelus
Pistus galeatus
Pardisomus biplagiatus
Lydamis cinnamomeus
Optatus palmaris
Telemus sp.
Somenes regestus
Anatorcus densus
Parasomenes curvirostris
Thaliabaris inermis
Coluthus cribrarius
Torcobius sp.
Torcus variabilis
Eumycterus albosquamulatus
Centrinogyna hispidula
Centrinogyna strigata
Microcholus striatus
Barinus bivittatus
Barinus cribricollis
Barilepton filiforme
Barilepton quadrieolle
Cylindridia prolixa
Sibariops concurrens
Rancea parviclava
Centrinopus alternatus
Centrinopus helvinus
Deipyrus hirsutulus
Aniops sculpturata
Aniops sp.
Psiona densa
Ethelda Squamosa
Oligolochus bracatus
Idiostethus subcalvus
Centrinites strigicollis
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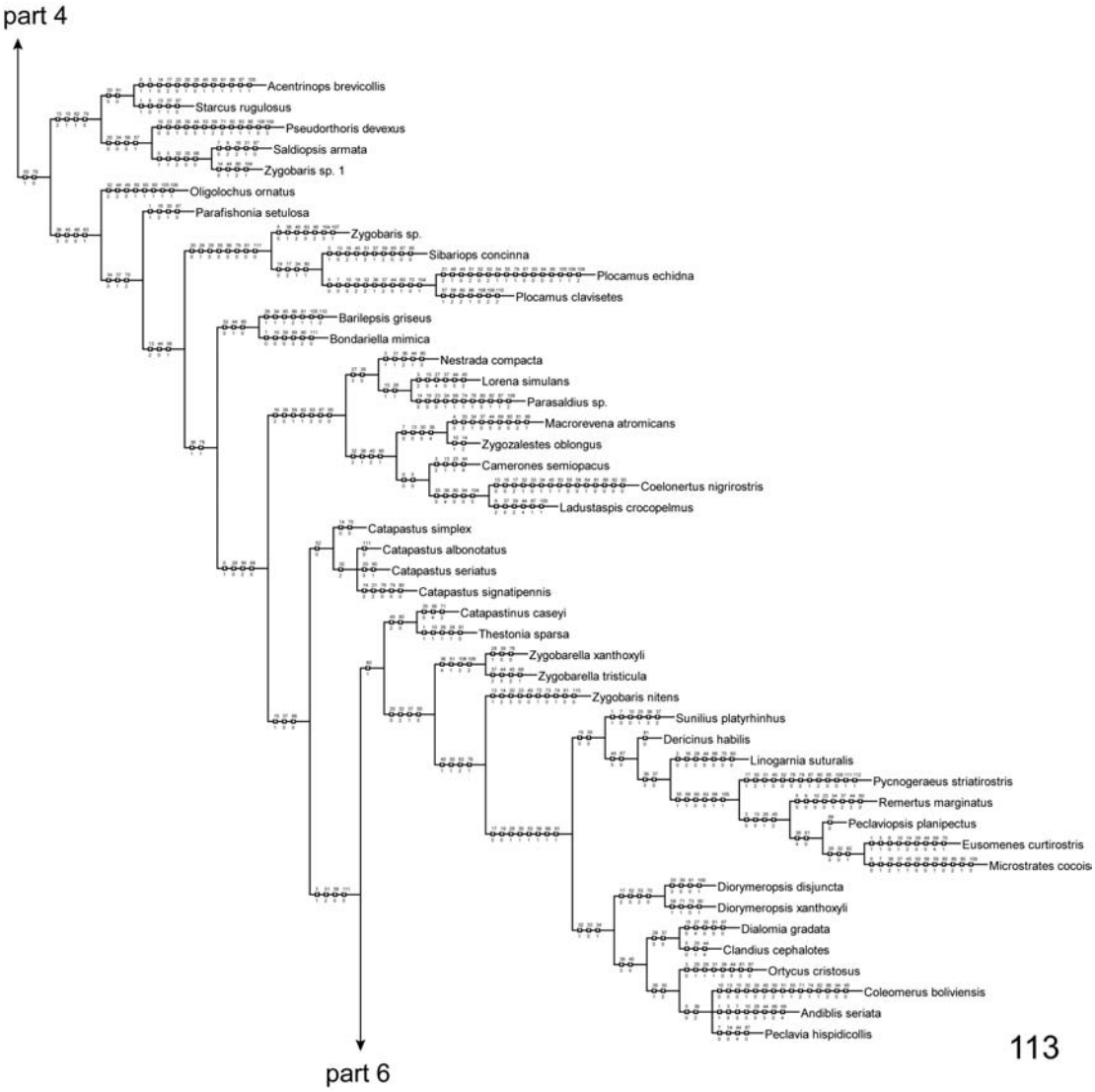
Buchananius striatus
Buchananius sulcatus
113
part 5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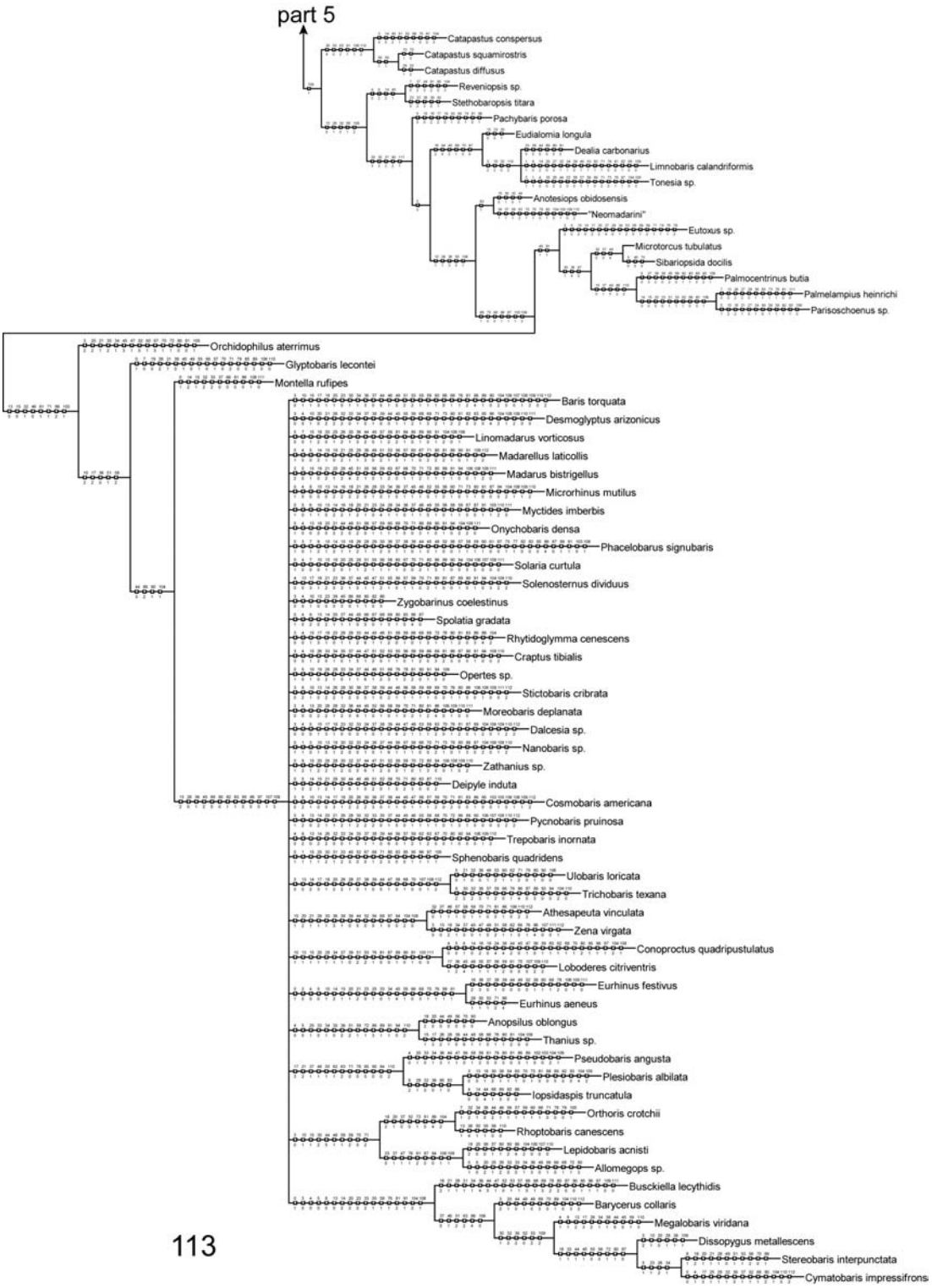
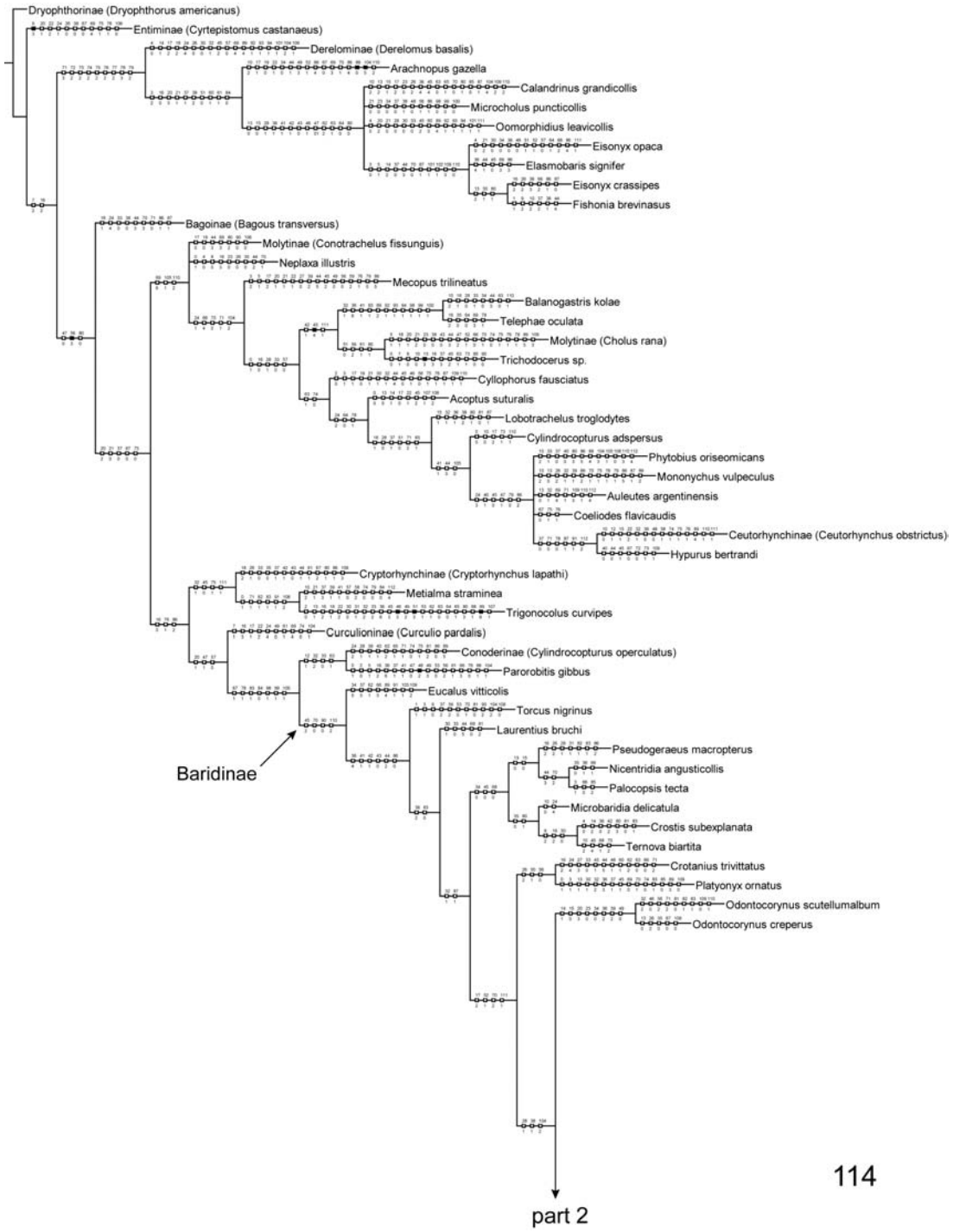
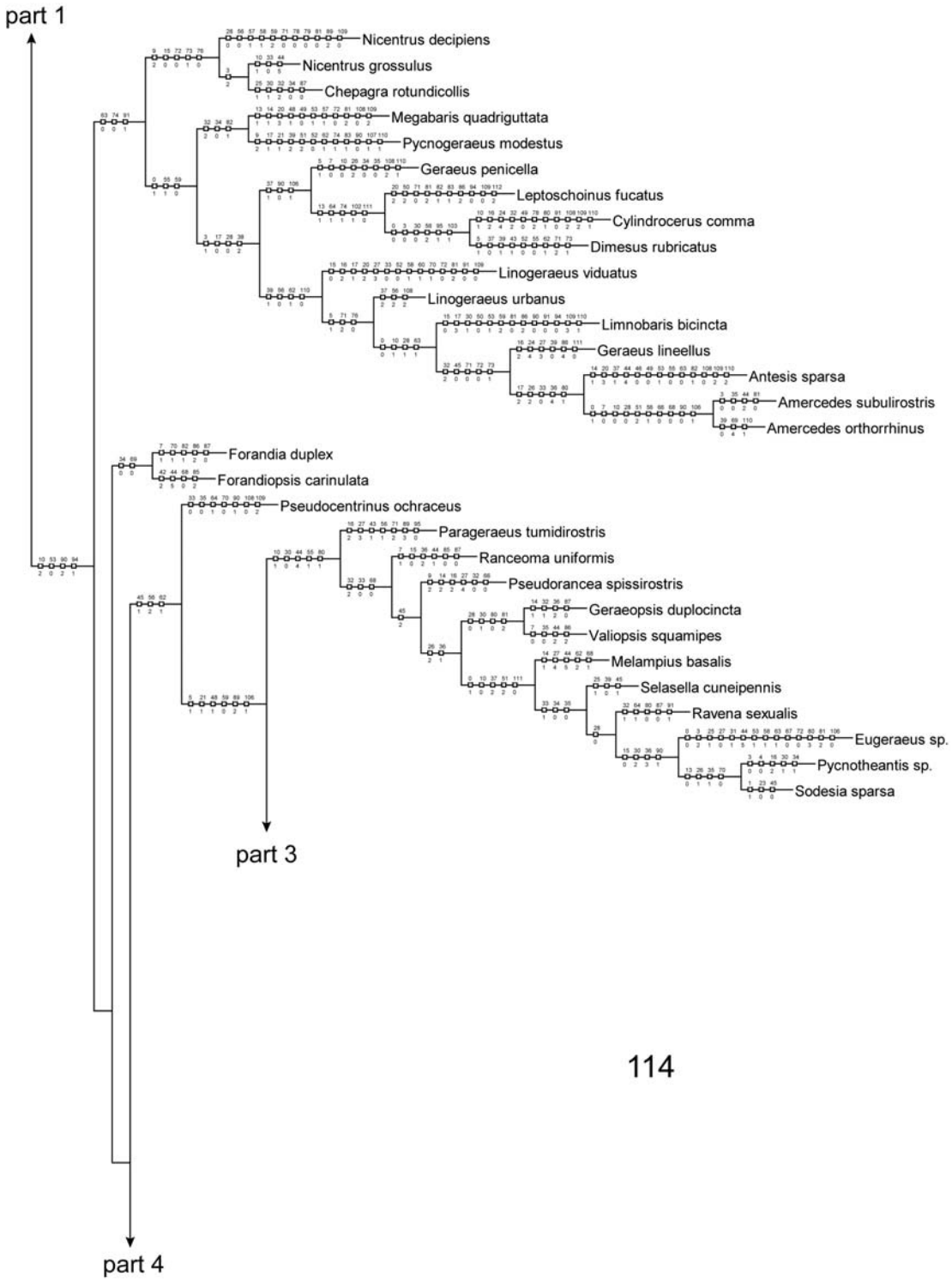
Starcus rugulosus
Pseudorthoris devexus
Saldiopsis armata
Zygobaris sp. 1
Oligolochus ornatus
Parafishonia setulosa
Zygobaris sp.
Sibariops concinna
Plocamus echidna
Plocamus clavisetes
Barilepsis griseus
Bondariella mimica
Nestrada compacta
Lorena simulans
Parasaldius sp.
Macrorevena atromicans
Zygozalestes oblongus
Camerones semiopacus
Coelonertus nigrirostris
Ladustaspis crocopelmus
Catapastus simplex
Catapastus albonotatus
Catapastus seriatus
Catapastus signatipennis
Catapastinus caseyi
Thestonia sparsa
Zygobarella xanthoxyli
Zygobarella tristicula
Zygobaris nitens
Sunilius platyrhinhus
Dericinus habilis
Linogarnia suturalis
Pycnogeraeus striatirostris
Remertus marginatus
Peclaviopsis planipectus
Eusomenes curtirostris
Microstrates cocois
Diorymeropsis disjuncta
Diorymeropsis xanthoxyli
Dialomia gradata
Clandius cephalotes
Ortycus cristosus
Coleomerus boliviensis
Andiblis seriata
Peclavia hispidicollis
113
part 6

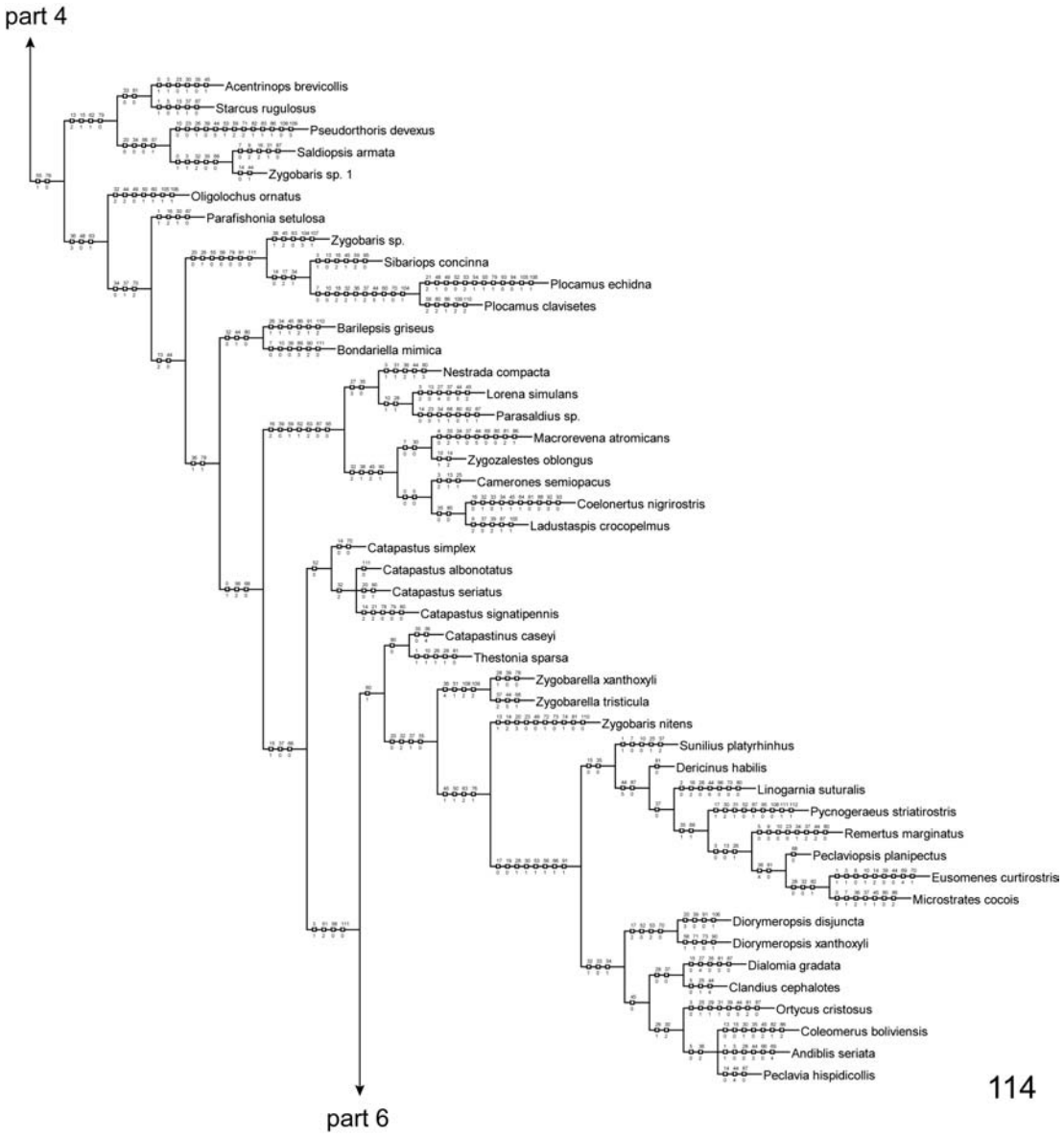

part 5
Catapastus conspersus
Catapastus squamirostris
Catapastus diffusus
Reveniopsis sp.
Stethobaropsis titara
Pachybaris porosa
Eudialomia longula
Dealia carbonarius
Limnobaris calandriformis
Tonesia sp.
Anotesiops obidosensis
"Neomadarini"
Eutoxus sp.
Microtorcus tubulatus
Sibariopsida docilis
Palmocentrinus butia
Palmelampius heinrichi
Parisoschoenus sp.
Orchidophilus aterrimus
Glyptobaris lecontei
Montella rufipes
Baris torquata
Desmoglyptus arizonicus
Linomadarus vorticosus
Madarellus laticollis
Madarus bistrigellus
Microrhinus mutilus
Myctides imberbis
Onychobaris densa
Phacelobarus signubaris
Solaria curtula
Solenosternus dividuus
Zygobarinus coelestinus
Spolatia gradata
Rhytidoglymma cenescens
Craptus tibialis
Opertes sp.
Stictobaris cribrata
Moreobaris deplanata
Dalcesia sp.
Nanobaris sp.
Zathanius sp.
Deipyle induta
Cosmobaris americana
Pycnobaris pruinosa
Trepobaris inornata
Sphenobaris quadridens
Ulobaris loricata
Trichobaris texana
Athesapeuta vinculata
Zena virgata
Conoproctus quadripustulatus
Loboderes citriventris
Eurhinus festivus
Eurhinus aeneus
Anopsilus oblongus
Thanius sp.
Pseudobaris angusta
Plesiobaris albilata
Iopsidaspis truncatula
Orthoris crotchii
Rhoptobaris canescens
Lepidobaris acnisti
Allomegops sp.
Buskiella lecythidis
Barycerus collaris
Megalobaris viridana
Dissopygus metallescens
Stereobaris interpunctata
Cymatobaris impressifrons
113


Dryophthorinae (Dryophthorus americanus)
Entiminae (Cyrtepistomus castanaeus)
Derelominae (Derelomus basalis)
Arachnopus gazella
Calandrinus grandicollis
Microcholus puncticollis
Oomorphidius leavicollis
Eisonyx opaca
Elasmobaris signifer
Eisonyx crassipes
Fishonia brevinasus
Bagoinae (Bagous transversus)
Molytinae (Conotrachelus fissunguis)
Neplaxa illustris
Mecopus trilineatus
Balanogastris kolae
Telephae oculata
Molytinae (Cholus rana)
Trichodocerus sp.
Cyllophorus fausciatus
Acoptus suturalis
Lobotrachelus troglodytes
Cylindrocopturus adspersus
Phytobius oriseomicans
Mononychus vulpeculus
Auleutes argentinensis
Coeliodes flavicaudis
Ceutorhynchinae (Ceutorhynchus obstrictus)
Hypurus bertrandi
Cryptorhynchinae (Cryptorhynchus lapathi)
Metialma straminea
Trigonocolus curvipes
Curculioninae (Curculio pardalis)
Conoderinae (Cylindrocopturus operculatus)
Parorobitis gibbus
Eucalus vitticolis
Torcus nigrinus
Laurentius bruchi
Baridinae
Pseudogeraeus macropterus
Nicentridia angusticollis
Palocopsis tecta
Microbaridia delicatula
Crostis subexplanata
Ternova biartita
Crotanius trivittatus
Platyonyx ornatus
Odontocorynus scutellumalbum
Odontocorynus creperus
114
part 2


part 1
Nicentrus decipiens
Nicentrus grossulus
Chepagra rotundicollis
Megabaris quadriguttata
Pycnogeraeus modestus
Geraeus penicella
Leptoschoinus fucatus
Cylindrocerus comma
Dimesus rubricatus
Linogeraeus viduatus
Linogeraeus urbanus
Limnobaris bicincta
Geraeus lineellus
Antesis sparsa
Amercedes subulirostris
Amercedes orthorrhinus
Forandia duplex
Forandiopsis carinulata
Pseudocentrinus ochraceus
Parageraeus tumidirostris
Ranceoma uniformis
Pseudorancea spissirostris
Geraeopsis duplocincta
Valiopsis squamipes
Melampius basalis
Selasella cuneipennis
Ravena sexualis
Eugeraeus sp.
Pycnotheantis sp.
Sodesia sparsa
part 3
part 4
114


part 2
Pachygeraeus laevirostris
Centrinus curvirostris
Megavallius auritarsis
Calorida binocularis
Microforandia uniformis
Saldius inaequalis
Barymerus binaries
Anavallius ruficornis
Lampobaris cicullata
Pseudosaldius conjunctus
Leptoladustes densus
Cryptosternum nevermanni
Ortycus setifer
Crostidia tenuipes
Diastethus eurthinoides
Leptogarnia polita
Tenemotes abdominalis
Tenemotes parviclava
Microstegotes sp.
Vallius sulcatus
Xystus ater
Xystus ruficollis
Fryella mutilatus
Nedestes sarpedon
Orissus christophori
Camelodes leachii
Orissus meigenii
Diorymerus lancifer
Hiotus inflatus
Prodinus sp.
Zalestes perpolitus
Microzalestes basalis
Garnia sp.
Testalthea sp.
Ovanius minutus
Stethobaris laevimargo
Stethobaroides nudiventris
Ovanius picipennis
Stethobaris commixta
Lasiobaris geminata
Pycnonicentrus gilvivestis
Centrinopsis sp.
Odontobaris sp.
Dactylocrepis flabellitarsis
Macrobaris sp.
Iops bicolor
Roalius rufipes
Scirpicola chilensis
Opseobaris alba
Strongylotes squamans
Nertinus suturalis
Trachymeropsis palmipes
Lipancylus brevirostris
Parallelosomus amplitarsis
Pacomes subglaber
Madopterus talpa
Lichnus longulus
Pacomes distortus
114

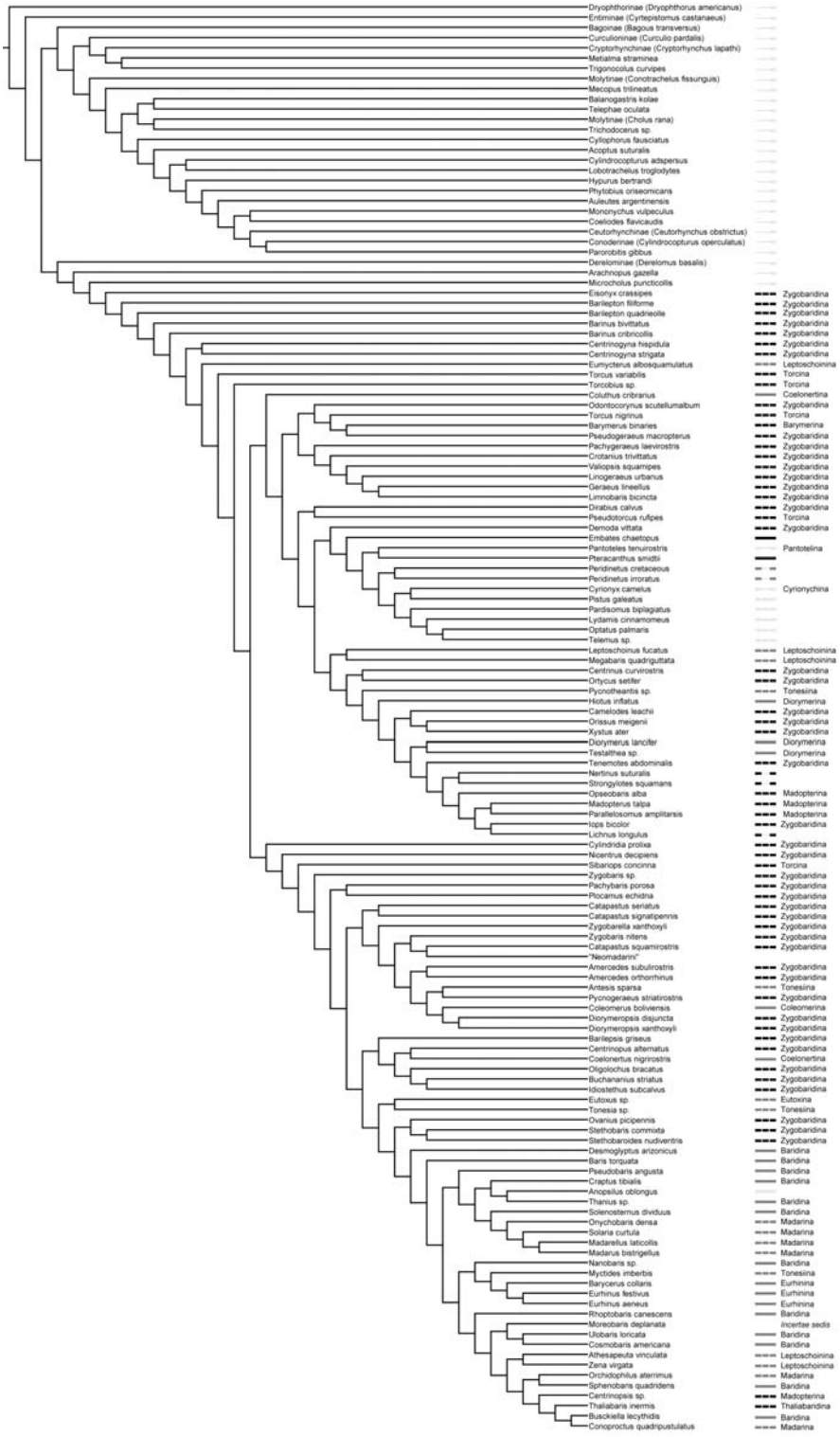

part 2
Pseudotorcus rufipes
Trichodirabius longulus
Dirabius calvus
Dirabius rectirostris
Valdenus laevis
Demoda vittata
Embates chaetopus
Pantoteles tenuirostris
Pteracanthus smidtii
Peridinetus cretaceous
Peridinetus irroratus
Cyrionyx camelus
Pistus galeatus
Pardisomus biplagiatus
Lydamis cinnamomeus
Optatus palmaris
Telemus sp.
Somenes regestus
Anatorcus densus
Parasomenes curvirostris
Thaliabaris inermis
Coluthus cribrarius
Torcobius sp.
Torcus variabilis
Eumycterus albosquamulatus
Centrinogyna hispidula
Centrinogyna strigata
Microcholus striatus
Barinus bivittatus
Barinus cribricollis
Barilepton filiforme
Barilepton quadrieolle
Cylindridia prolixa
Sibariops concurrens
Rancea parviclava
Centrinopus alternatus
Centrinopus helvinus
Deipyrus hirsutulus
Aniops sculpturata
Aniops sp.
Psiona densa
Ethelda Squamosa
Oligolochus bracatus
Idiostethus subcalvus
Centrinites strigicollis
Idiostethus tubulatus
Haplostethops ellipsoidea
Buchananius striatus
Buchananius sulcatus
part 5
114


part 4
Acentrinops brevicollis
Starcus rugulosus
Pseudorthoris devexus
Saldiopsis armata
Zygobaris sp. 1
Oligolochus ornatus
Parafishonia setulosa
Zygobaris sp.
Sibariops concinna
Plocamus echidna
Plocamus clavisetes
Barilepsis griseus
Bondariella mimica
Nestrada compacta
Lorena simulans
Parasaldius sp.
Macrorevena atromicans
Zygozalestes oblongus
Camerones semiopacus
Coelonertus nigrirostris
Ladustaspis crocopelmus
Catapastus simplex
Catapastus albonotatus
Catapastus seriatus
Catapastus signatipennis
Catapastinus caseyi
Thestonia sparsa
Zygobarella xanthoxyli
Zygobarella tristicula
Zygobaris nitens
Sunilius platyrhinhus
Dericinus habilis
Linogarnia suturalis
Pycnogeraeus striatirostris
Remertus marginatus
Peclaviopsis planipectus
Eusomenes curtirostris
Microstrates cocois
Diorymeropsis disjuncta
Diorymeropsis xanthoxyli
Dialomia gradata
Clandius cephalotes
Ortycus cristosus
Coleomerus boliviensis
Andiblis seriata
Peclavia hispidicollis
114
part 6

part 5


Catapastus conspersus
Catapastus squamirostris
Catapastus diffusus
Reveniopsis sp.
Stethobaropsis titara
Pachybaris porosa
Eudialomia longula
Dealia carbonarius
Limnobaris calandriformis
Tonesia sp.
Anotesiops obidosensis
"Neomadarini"
Eutoxus sp.
Microtorcus tubulatus
Sibariopsida docilis
Palmocentrinus butia
Palmelampius heinrichi
Parisoschoenus sp.
Orchidophilus aterrimus
Glyptobaris lecontei
Montella rufipes
Baris torquata
Desmoglyptus arizonicus
Linomadarus vorticosus
Madarellus laticollis
Madarus bistrigellus
Microrhinus mutilus
Myctides imberbis
Onychobaris densa
Phacelobarus signubaris
Solaria curtula
Solenosternus dividuus
Zygobarinus coelestinus
Spolatia gradata
Rhytidoglymma cenescens
Craptus tibialis
Opertes sp.
Stictobaris cribrata
Moreobaris deplanata
Dalcesia sp.
Nanobaris sp.
Zathanius sp.
Deipyle induta
Cosmobaris americana
Pycnobaris pruinosa
Trepobaris inornata
Sphenobaris quadridens
Ulobaris loricata
Trichobaris texana
Athesapeuta vinculata
Zena virgata
Conoproctus quadripustulatus
Lobodères citriventris
Eurhinus festivus
Eurhinus aeneus
Anopsilus oblongus
Thanius sp.
Pseudobaris angusta
Plesiobaris albilata
Iopsidaspis truncatula
Orthoris crotchii
Rhoptobaris canescens
Lepidobaris acnisti
Allomegops sp.
Busckiella lecythidis
Barycerus collaris
Megalobaris viridana
Dissopygus metallescens
Stereobaris interpunctata
Cymatobaris impressifrons

114


Dryophthorinae (Dryophthorus americanus)
Entiminae (Cyrtepistomus castaneus)
Bagoinae (Bagous transversus)
Curculioninae (Curculio pardalis)
Cryptorhynchinae (Cryptorhynchus lapathi)
Metialma straminea
Trigonocolus curvipes
Molytinae (Conotrachelus fissunguis)
Mecopus trilineatus
Balanogastris kolae
Telephae oculata
Molytinae (Cholus rana)
Trichodocerus sp.
Cyllophorus fausciatus
Acoptus suturalis
Cylindrocopturus adspersus
Lobotrachelus troglodytes
Hypurus bertrandi
Phytobius oriseomicans
Auleutes argentinensis
Moniorychus vulpeculus
Coeliodes flavicaudis
Ceutorhynchinae (Ceutorhynchus obstrictus)
Conoderinae (Cylindrocopturus operculatus)
Parorobitis gibbus
Dereliominae (Derelomus basalis)
Arachnopus gazella
Microcholus punctiicollis
Eisonyx crassipes
Barilepton filiforme
Barilepton quadrieolle
Barinus bivittatus
Barinus cribricollis
Centrinogyna hispidula
Centrinogyna strigata
Eumycterus albosquamulatus
Torcus variabilis
Torcobius sp.
Coluthus cribrarius
Odontocorynus scutellumalbum
Torcus nigrinus
Barymerus binaries
Pseudogeraeus macropterus
Pachygeraeus laevirostris
Crotanius trivittatus
Valiopsis squamipes
Linogeraeus urbanus
Geraeus lineellus
Limnobaris bicincta
Dirabius calvus
Pseudotorcus rufipes
Dermoda vittata
Embates chaetopus
Pantoteles tenuirostris
Pteracanthus smidti
Peridinetus cretaceous
Peridinetus irroratus
Cyrionyx camelus
Pistus galeatus
Pardisomus biplagiatus
Lydamis cinnamomeus
Optatus palmaris
Telemus sp.
Leptoschoinus fucatus
Megabaris quadriguttata
Centrinus curvirostris
Ortycus setifer
Pyonotheantis sp.
Hiotus inflatus
Camelodes leachii
Orissus meigenii
Xystus ater
Diorymerus lanciter
Testalthea sp.
Tenemotes abdominalis
Nertinus suturalis
Strongylotes squamans
Opseobaris alba
Madopterus talpa
Parallelosomus amplitarsis
Iops bicolor
Lichnus longulus
Cylindridia prolixa
Nicentrus decipiens
Sibariops concinna
Zygobaris sp.
Pachybaris porosa
Plocamus echidna
Catapastus seriatus
Catapastus signatipennis
Zygobarella xanthoxyli
Zygobaris nitens
Catapastus squamirostris
"Neomadarini"
Amercedes subulirostris
Amercedes orthorhinus
Antesis sparsa
Pyonogeraeus striatirostris
Coleomerus boliviensis
Diorymeropsis disjuncta
Diorymeropsis xanthoxyli
Barilepsis griseus
Centrinopus alternatus
Coelonertus nigricostris
Oligolochus bracatus
Buchananius striatus
Idiostethus subcalvus
Eutoxus sp.
Tonesia sp.
Ovanius picipennis
Stethobaris commixta
Stethobaroides nudiventris
Desmoglyptus arizonicus
Baris torquata
Pseudobaris angusta
Craptus tibialis
Anopsilus oblongus
Thanius sp.
Solenosternus dividuus
Onychobaris densa
Solaria curtula
Madarellus laticollis
Madarus bistrigellus
Nanobaris sp.
Myctides imberbis
Barycerus collaris
Eurhinus festivus
Eurhinus aeneus
Rhoptobaris canescens
Moreobaris deplanata
Ulobaris loricata
Cosmobaris americana
Athesapeuta vinculata
Zena virgata
Orchodophilus aterrimus
Sphenobaris quadridens
Centrinopsis sp.
Thalabaris inermis
Buskiella lecythidis
Conoproctus quadripustulatus
Zygobaridina
Zygobaridina
Zygobaridina
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Zygobaridina
Zygobaridina
Leptoschoinina
Torcina
Torcina
Coelonertina
Zygobaridina
Torcina
Barymerina
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Torcina
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Cyrionychina
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Leptoschoinina
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Tonesiina
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Zygobaridina
Coleomerina
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Madarina
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Madarina
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Baridina
Tonesiina
Eurhinina
Eurhinina
Eurhinina
Baridina
incertae sedis
Baridina
Baridina
Leptoschoinina
Leptoschoinina
Madarina
Baridina
Madopterina
Thalabaridina
Baridina
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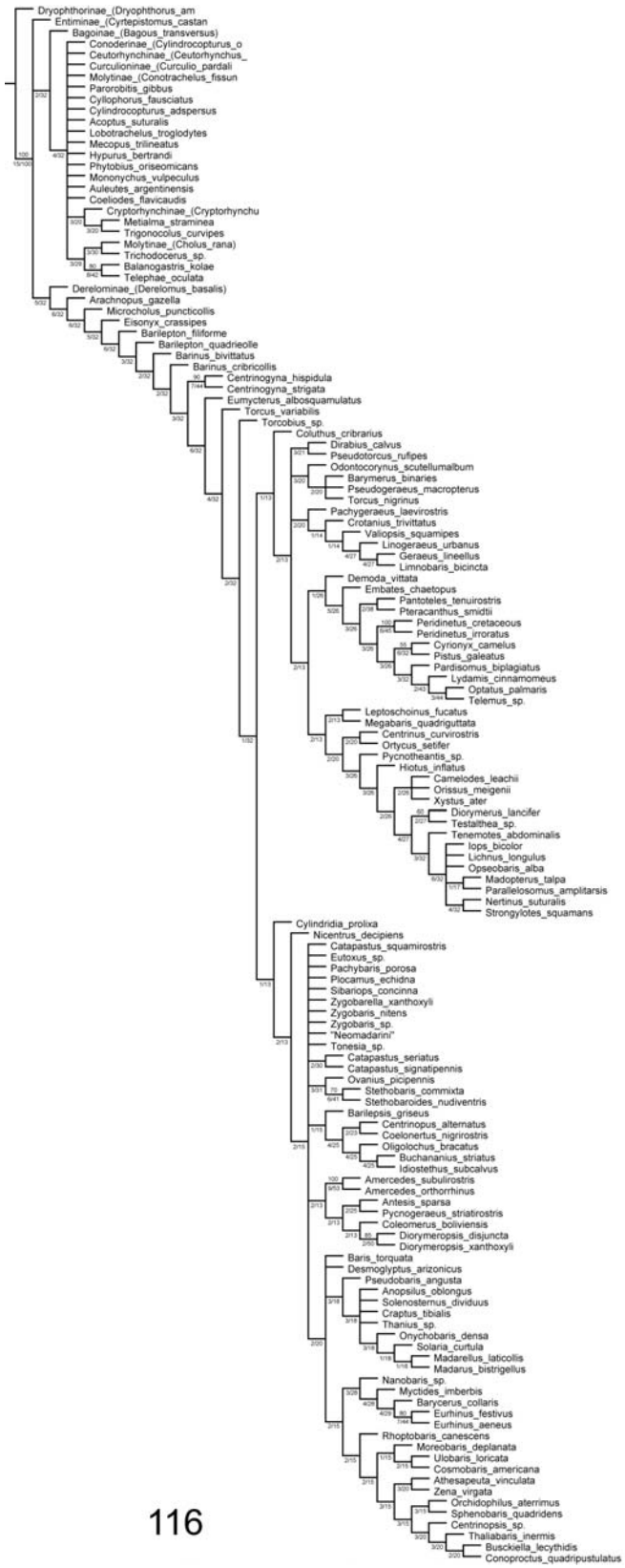
Baridini
Madarini
Madopterini
Nertinini
Optatini
Pantotelini
Peridinetini
outgroup

115


Dryophthorinae_(Dryophthorus_am
Entiminae_(Cyrtepistomus_castan
Bagoinae_(Bagous_transversus)
Conoderinae_(Cylindrocopturus_o
Ceutorhynchinae_(Ceutorhynchus_
Curculioninae_(Curculio_pardali
Molytinae_(Conotrachelus_fissun
Pararobitis_gibbus
Cyllophorus_fausciatus
Cylindrocopturus_adspersus
Acoptus_suturalis
Lobotrachelus_troglodytes
Mecopus_trilineatus
Hypurus_bertrandi
Phytobius_oriseomicans
Mononychus_vulpeculus
Auleutes_argentinensis
Coeliodes_flavicaudis
Cryptorhynchinae_(Cryptorhynchu
Metialma_straminea
Trigonocolus_curvipes
Molytinae_(Cholus_rana)
Trichodocerus_sp.
Balanogastris_kolae
Telephae_oculata
Derelominae_(Derelomus_basalis)
Arachnopus_gazella
Microcholus_puncticollis
Eisonyx_crassipes
Barilepton_filiforme
Barilepton_quadrieolle
Barinus_bivittatus
Barinus_cribricollis
Centrinogyna_hispidula
Centrinogyna_strigata
Eumycterus_albosquamulatus
Torcus_variabilis
Torcobius_sp.
Coluthus_cribrarius
Dirabius_calvus
Pseudotorcus_rufipes
Odontocorynus_scutellumalbum
Barymerus_binaries
Pseudogeraeus_macropterus
Torcus_nigrinus
Pachygeraeus_laevirostris
Crotanius_trivittatus
Valiopsis_squamipes
Linogeraeus_urbanus
Geraeus_lineellus
Limnobaris_bicincta
Demoda_vittata
Embates_chaetopus
Pantoteles_tenuirostris
Pteracanthus_smidtii
Peridinetus_cretaceous
Peridinetus_irroratus
Cyrionyx_camelus
Pistus_galeatus
Pardisomus_biplagiatus
Lydamis_cinnamomeus
Optatus_palmaris
Telemus_sp.
Leptoschoinus_fucatus
Megabaris_quadriguttata
Centrinus_curvirostris
Ortycus_setifer
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Xystus_ater
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Testalthea_sp.
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Iops_bicolor
Lichnus_longulus
Opseobaris_alba
Madopterus_talpa
Parallelosomus_amplitarsis
Nertinus_suturalis
Strongylotes_squamans
Cylindridia_prolixa
Nicentrus_decipiens
Catapastus_squamirostris
Eutoxus_sp.
Pachybaris_porosa
Plocamus_echidna
Sibariops_concinna
Zygobarella_xanthoxyli
Zygobaris_nitens
Zygobaris_sp.
"Neomadarini"
Tonesia_sp.
Catapastus_seriatus
Catapastus_signatipennis
Ovanius_picipennis
Stethobaris_commixta
Stethobaroides_nudiventris
Barilepsis_griseus
Centrinopus_alternatus
Coelonertus_nigrirostris
Oligolochus_bracatus
Buchananius_striatus
Idiostethus_subcalvus
Amercedes_subulirostris
Amercedes_orthorhinus
Antesis_sparsa
Pycnogeraeus_striatirostris
Coleomerus_boliviensis
Diorymeropsis_disjuncta
Diorymeropsis_xanthoxyli
Baris_torquata
Desmoglyptus_arizonicus
Pseudobaris_angusta
Anopsilus_oblongus
Solenosternus_dividuus
Craptus_tibialis
Thanius_sp.
Onychobaris_densa
Solaria_curtula
Madarellus_laticollis
Madarus_bistrigellus
Nanobaris_sp.
Myctides_imberbis
Barycerus_collaris
Eurhinus_festivus
Eurhinus_aeneus
Rhoptobaris_canescens
Moreobaris_deplanata
Ulobaris_loricata
Cosmobaris_americana
Athesapeuta_vinculata
Zena_virgata
Orchidophilus_aterrimus
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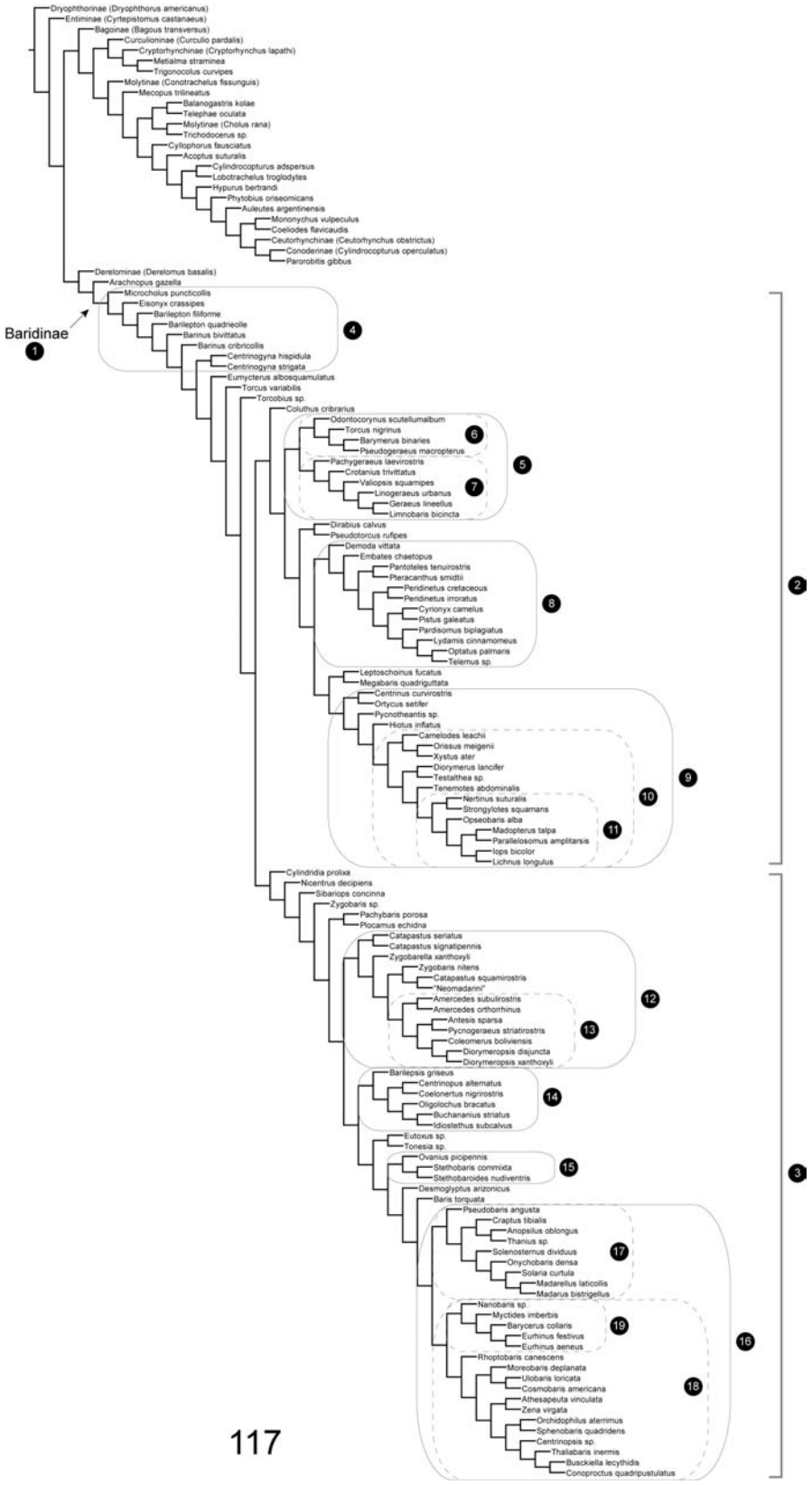
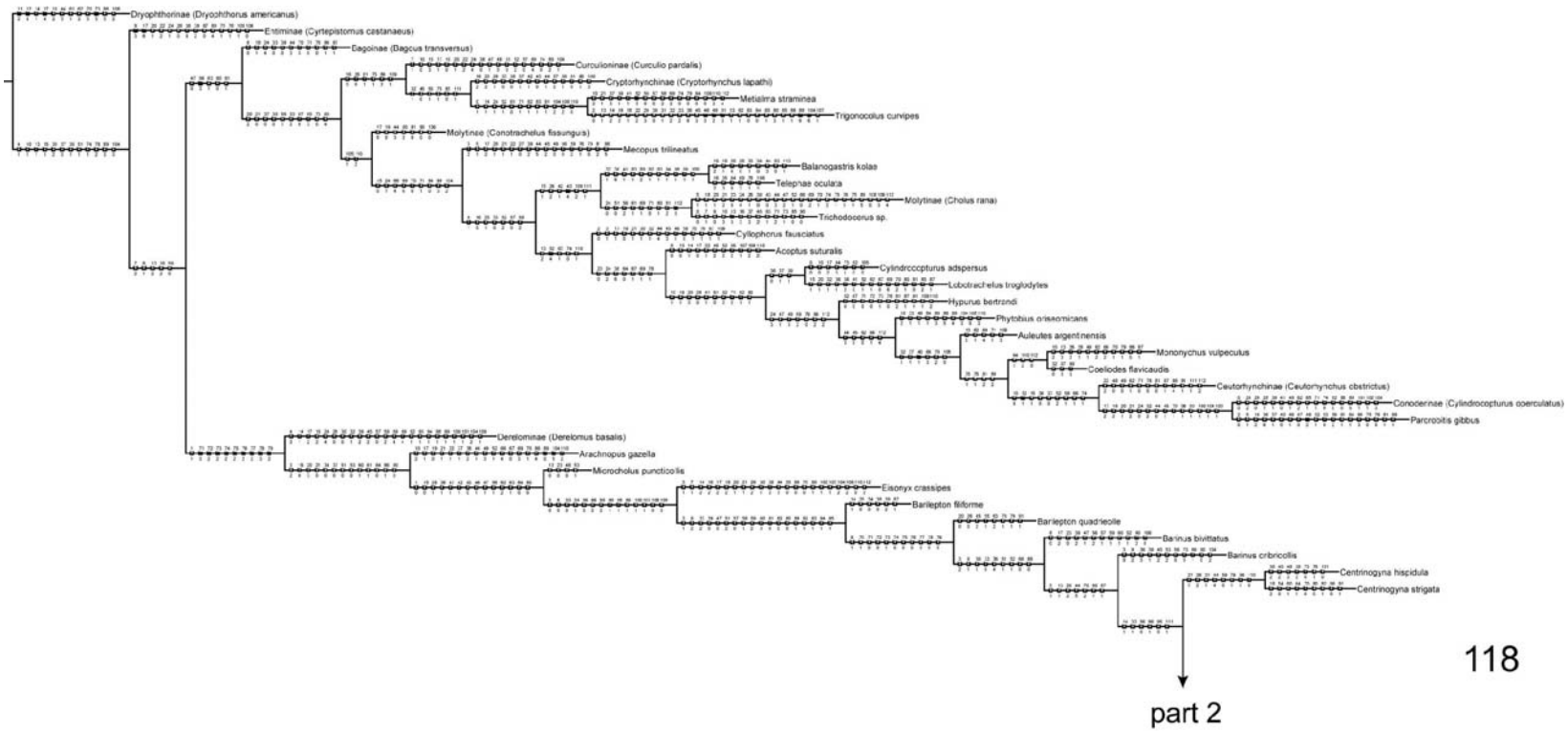
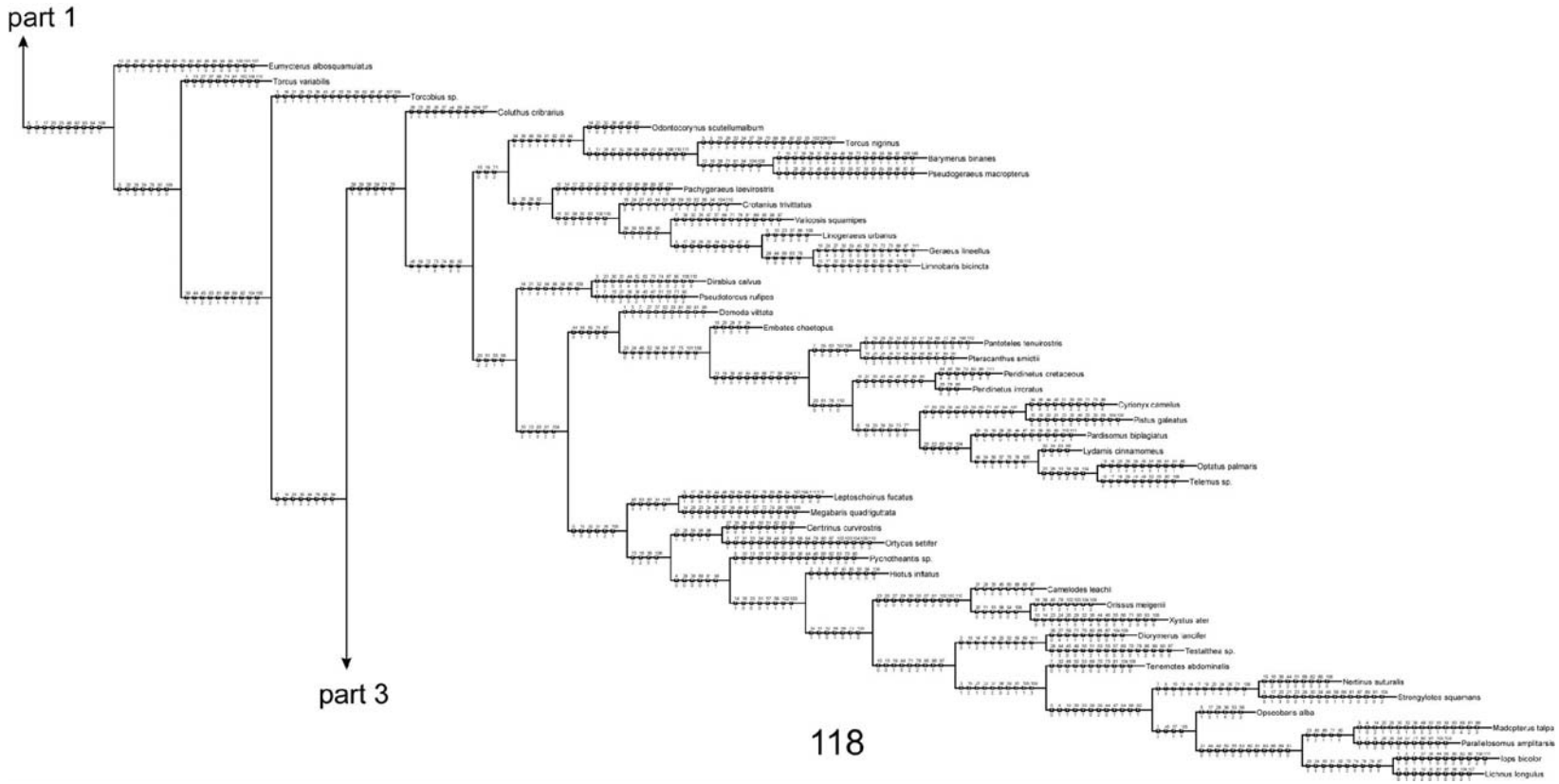
Thallabaris_inermis
Busckiella_lecythidis
Conoproctus_quadripustulatus

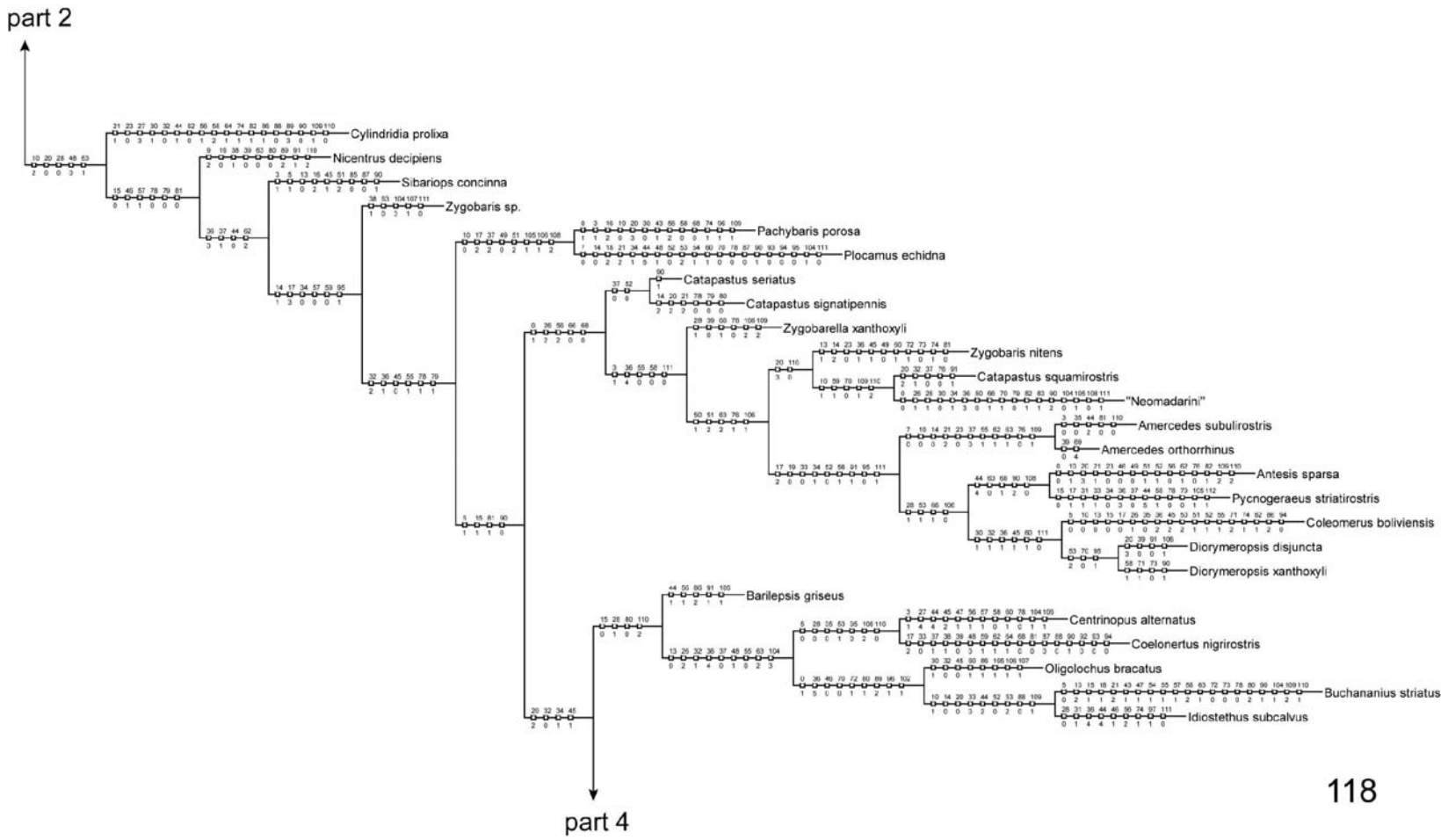
116

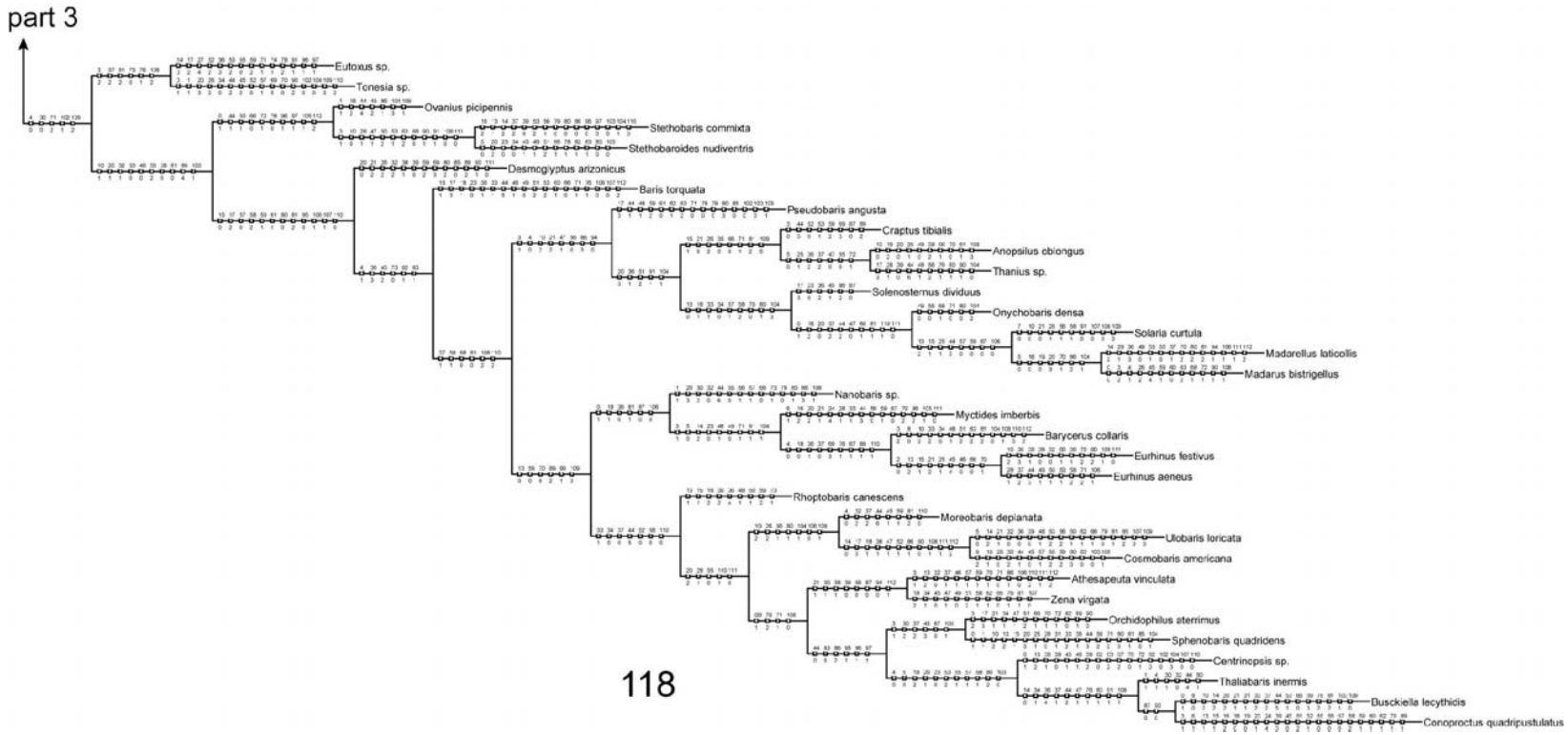

Dryophthorinae (Dryophthorus americanus)
Entiminae (Cyrtepistomus castanaeus)
Bagoinae (Bagous transversus)
Curculioninae (Curculio pardalis)
Cryptorhynchinae (Cryptorhynchus lapathi)
Metialma straminea
Trigonocolus curvipes
Molytinae (Conotrachelus fissunguis)
Mecopus trilineatus
Balanogastris kolae
Telephae oculata
Molytinae (Cholus rana)
Trichodocerus sp.
Cyllophorus fausciatus
Acoptus suturalis
Cylindrocopturus adspersus
Lobotrachelus troglodytes
Hypurus bertrandi
Phytobius oriseomicans
Auleutes argentinensis
Mononychus vulpeculus
Coeliodes flavicaudis
Ceutorhynchinae (Ceutorhynchus obstrictus)
Conoderinae (Cylindrocopturus operculatus)
Pararobitis gibbus
Derelominae (Derelomus basalis)
Arachnopus gazella
Microcholus puncticollis
Eisonyx crassipes
Barilepton filiforme
Barilepton quadrieolle
Barinus bivittatus
Baridinae
1
Barinus cribricollis
Centrinogyna hispidula
Centrinogyna strigata
4
Eumycterus albosquamulatus
Torcus variabilis
Torcobius sp.
Coluthus cribrarius
Odontocorynus scutellumalbum
Torcus nigrinus
Barymerus binaries
6
Pseudogeraeus macropterus
5
Pachygeraeus laevirostris
Crotanius trivittatus
Valiopsis squamipes
7
Linogeraeus urbanus
Geraeus lineellus
Limnobaris bicincta
Dirabius calvus
Pseudotorcus rufipes
Demoda vittata
Embates chaetopus
Pantoteles tenuirostris
Pteracanthus smidtii
Peridinetus cretaceous
Peridinetus irroratus
8
Cyrionyx carnelus
Pistus galeatus
Pardisomus biplagiatus
Lydamis cinnamomeus
Optatus palmaris
Telemus sp.
Leptoschoinus fucatus
Megabaris quadriguttata
Centrinus curvirostris
Ortycus setifer
Pycnotheantis sp.
Hiotus inflatus
Camelodes leachii
Orissus meigeni
Xystus ater
Diorymerus lancifer
Testalthea sp.
9
Tenemotes abdominalis
10
Nertinus suturalis
Strongylotes squamans
Opseobaris alba
11
Madopterus talpa
Parallelosomus amplitarsis
Iops bicolor
Lichnus longulus
2
Cylindridia prolixa
Nicentrus decipiens
Sibariops concinna
Zygobaris sp.
Pachybaris porosa
Plocamus echidna
Catapastus seriatus
Catapastus signatipennis
Zygobarella xanthoxyli
Zygobaris nitens
Catapastus squamirostris
"Neomadarini"
12
Amercedes subulirostris
Amercedes orthorhinus
Antesis sparsa
13
Pycnogeraeus striatirostris
Coleomerus boliviensis
Diorymeropsis disjuncta
Diorymeropsis xanthoxyli
Barilepsis griseus
Centrinopus alternatus
Coelonertus nigrirostris
14
Oligolochus bracatus
Buchananius striatus
Idiostethus subcalvus
Eutoxus sp.
Tonesia sp.
Ovanius picipennis
15
Stethobaris commixta
Stethobaroides nudiventris
Desmoglyptus arizonicus
Baris torquata
Pseudobaris angusta
Craptus tibialis
Anopsilus oblongus
Thanius sp.
17
Solenosternus dividuus
Onychobaris densa
Solaria curtula
Madarellus laticollis
Madarus bistrigellus
Nanobaris sp.
Myctides imberbis
19
Baryocerus collaris
Eurhinus festivus
Eurhinus aeneus
16
Rhoptobaris canescens
Moreobaris deplanata
Uobaris loricata
Cosmobaris americana
18
Athesapeuta vinculata
Zena virgata
Orchidophilus aterrimus
Sphenobaris quadridens
Centrinopsis sp.
Thallabaris inermis
Buskiella lecythidis
Conoproctus quadripustulatus
3

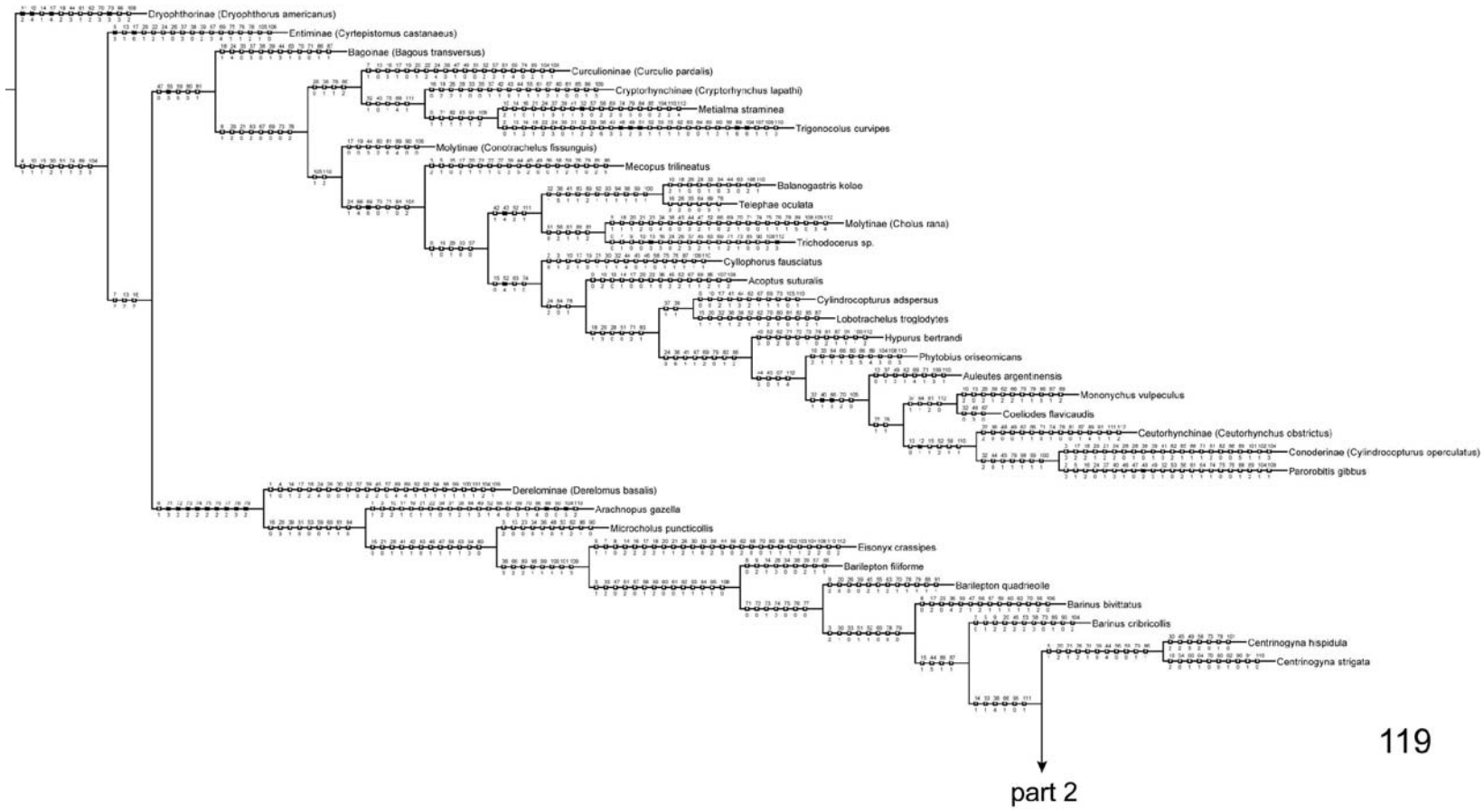
117


Dryophthorinae (Dryophthorus americanus)
Entiminae (Cyrtepistomus castanaeus)
Bagoinae (Bagous transversus)
Curculioninae (Curculio pardalis)
Cryptorhynchinae (Cryptorhynchus lapathi)
Metialma straminea
Trigonocolus curvipes
Molytinae (Conotrachelus fissungus)
Mecopus trilineatus
Balanogastris kolae
Telephae ocularis
Molytinae (Cholus rana)
Trichodocerus sp.
Cyllophorus fasciatus
Acoptus suturalis
Cylindrocopturus adspersus
Lobotrachelus troglodytes
Hypurus bertrandi
Phytobius orisaomicans
Auleutes argentinensis
Mononychus vulpeculus
Coeliodes flavicaudis
Ceutorhynchinae (Ceutorhynchus obstrictus)
Conoderinae (Cylindrocopturus coerculatus)
Parcrotitis gibbus
Derelominae (Derelomus basalis)
Arachnopus gazella
Microcholus punctiocollis
Eisonyx crassipes
Barileptonn filiforme
Barleptonn quadrioelle
Barinus bivittatus
Barinus cribricollis
Centrinogyna hispidula
Centrinogyna strigata
part 2

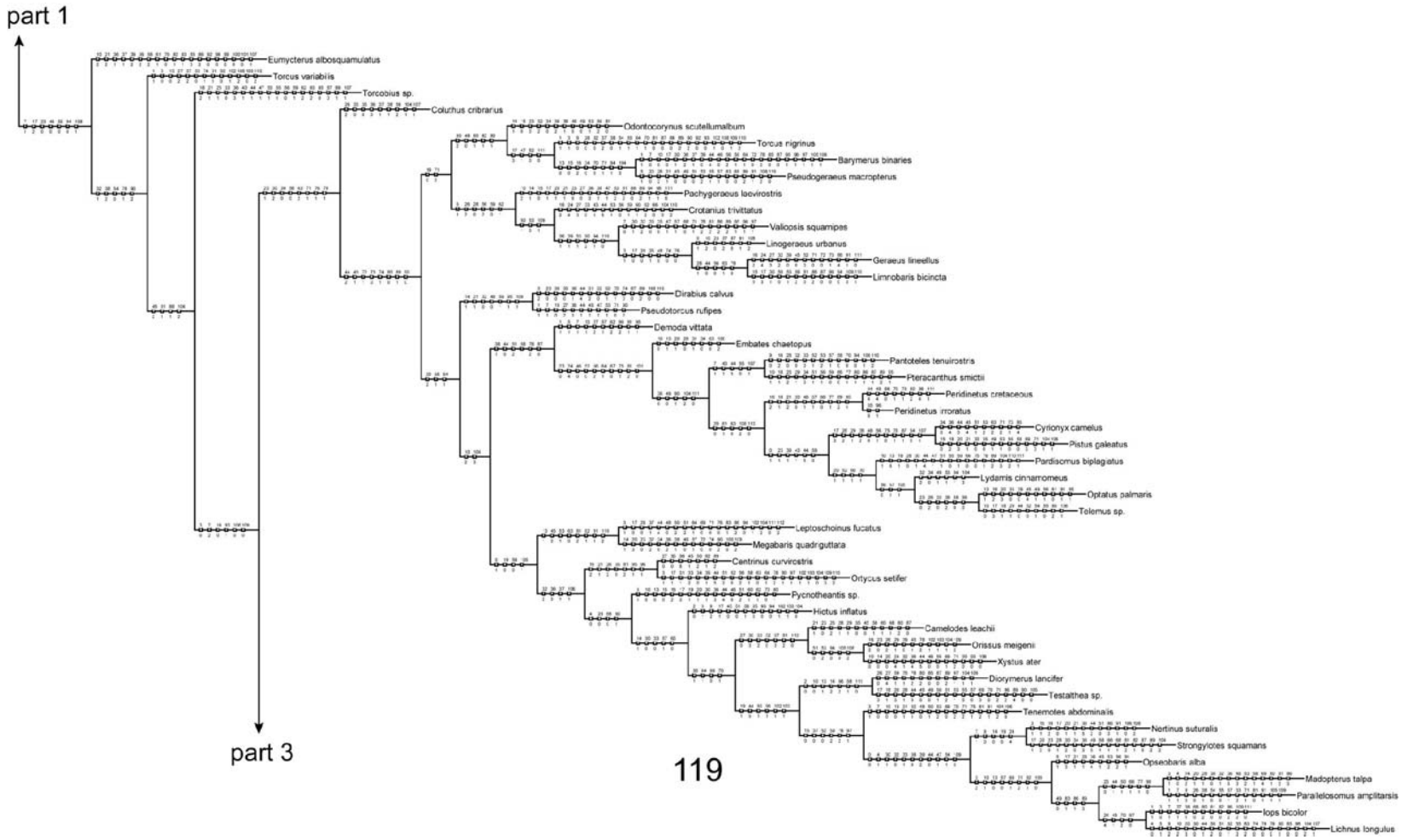

part 1
Eumycerus albosquamulatus
Torcus variabilis
Torcobius sp.
Coluthus cribrarius
Odontocorynus scutellumalbum
Torcus nigrinus
Barymerus binanes
Pseudogeraeus macropterus
Pachygeraeus laevirostris
Crotanius trivittatus
Varicosis squamipes
Linogeraeus urbanus
Geraeus lineellus
Limnobaris bicincta
Dirabius celvus
Pseudotorcus rufipes
Domoda vittata
Embates choetopus
Pantoteles tenuirostris
Pteracanthus smictii
Peridinetus cretaceous
Peridinetus irroratus
Cyrionyx camelus
Pistus galeatus
Pardisomus bipliglatus
Lydamis cinnamomeus
Optatus palmaris
Telemus sp.
Leptoschoinus fucatus
Megabaris quadriguttata
Certrinus curvirostris
Ortycus setifer
Pycnotheantis sp.
Hiotus inflatus
Camelodes leachi
Crissus meigenii
Xystus ater
Diorymerus ancifer
Testalthea sp.
Teremotes abdominalis
Nedinus suturalis
Strongylotes squamans
Opseobaris alba
Madopterus talpa
Parallelosomus amplitarsis
Iops bicolor
Lichnus longulus
part 3
118

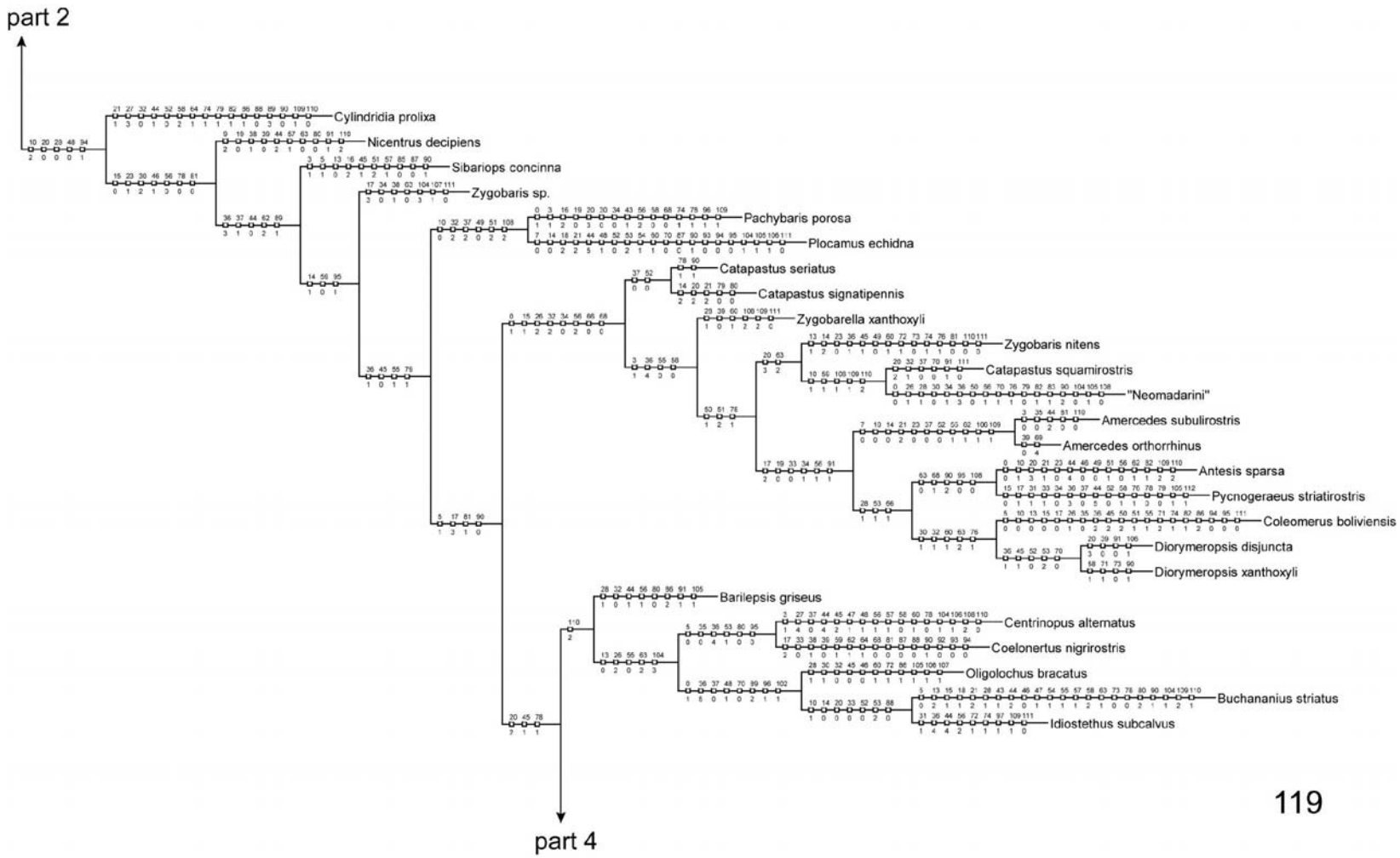

part 2
Cylindridia prolixa
Nicentrus decipiens
Sibariops concinna
Zygobaris sp.
Pachybaris porosa
Placamus echidna
Catapastus seriatus
Catapastus signatipennis
Zygobarella xanthoxyli
Zygobaris nitens
Catapastus squamirostris
"Neomadarini"
Amercedes subulirostris
Amercedes orthorrhinus
Antesis sparsa
Pycnogeraeus striatirostris
Coleomerus boliviensis
Diorymeropsis disjuncta
Diorymeropsis xanthoxyli
Barilepsis griseus
Centrinopus alternatus
Coelonertus nigrirostris
Oligolochus bracatus
Buchananius striatus
Idiostethus subcalvus
part 4


part 3
Eutoxus sp.
Tcnesia sp.
Ovanius picipennis
Stethobaris commixta
Stethobaroides nudiventris
Desmoglyptus arizonicus
Baris torquata
Pseudobaris angusta
Craptus tibialis
Anopsilus cbiongus
Thanius sp.
Solenosternus dividuus
Onychobaris densa
Solaria curtula
Madarellus laticollis
Madarus bistrigellus
Nanobaris sp.
Myctides imberbis
Barycerus collaris
Eurhinus festivus
Eurhinus aeneus
Rhoptobaris canescens
Moreobaris depianata
Ulobaris loricata
Cosmobaris americana
Athesapeuta vinculata
Zena virgata
Orchidophilus aterrimus
Sphenobaris quadricens
Centrincpsis sp.
Thaliabaris inermis
Busckiella lecythicis
Conoproctus quadripustulatus

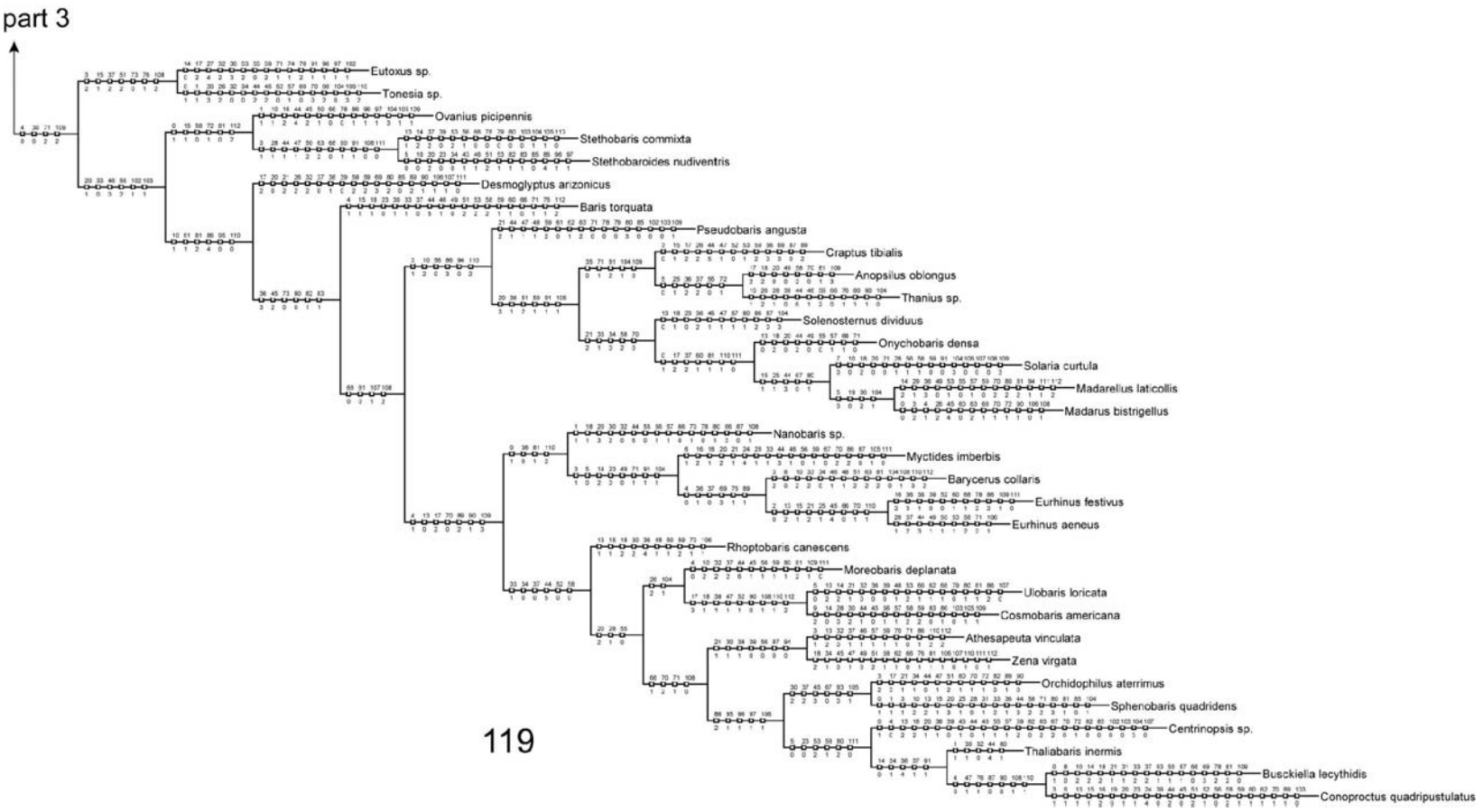

Dryophthorinae (Dryophthorus americanus)
Entiminae (Cyrtepistomus castanaeus)
Bagoinae (Bagous transversus)
Curculioninae (Curculio pardalis)
Cryptorhynchinae (Cryptorhynchus lapathi)
Metialma straminea
Trigonocolus curvipes
Molytinae (Conotrachelus fissunguis)
Mecopus trilineatus
Balanogastris kolae
Telephae oculata
Molytinae (Cholus rana)
Trichodocerus sp.
Cyllophorus fausciatus
Acoptus suturalis
Cylindrocopturus adspersus
Lobotrachelus troglodytes
Hypurus bertrandi
Phytobius oriseomicans
Auleutes argentinensis
Mononychus vulpeculus
Coeliodes flavicaudis
Ceutorhynchinae (Ceutorhynchus obstrictus)
Conoderinae (Cylindrocopturus operculatus)
Parorobitis gibbus
Derelominae (Derelomus basalis)
Arachnopus gazella
Microcholus punctiollis
Eisonyx crassipes
Barilepton filiforme
Barilepton quadrieolle
Barinus bivittatus
Barinus cribricollis
Centrinogyna hispidula
Centrinogyna strigata

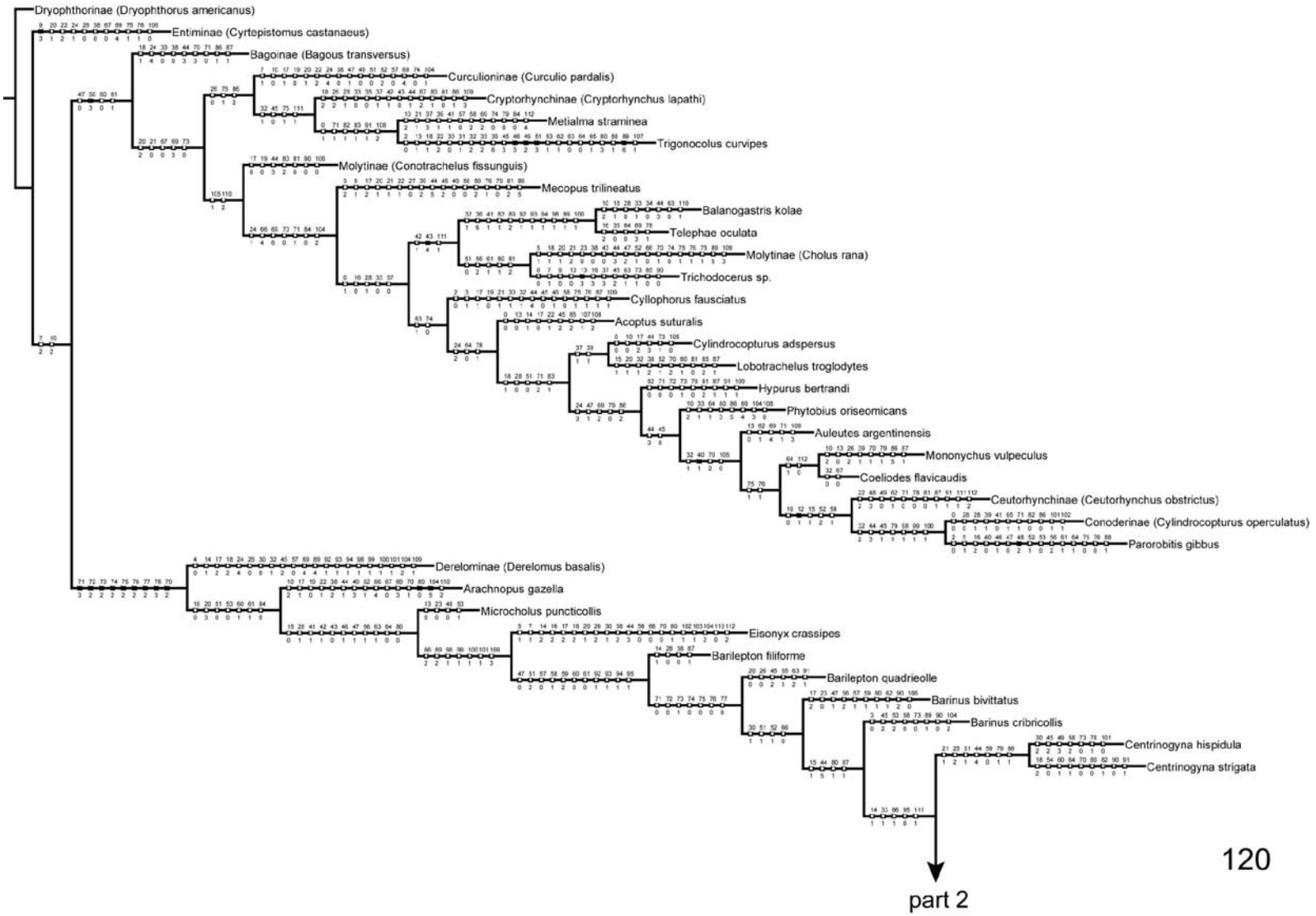
part 2

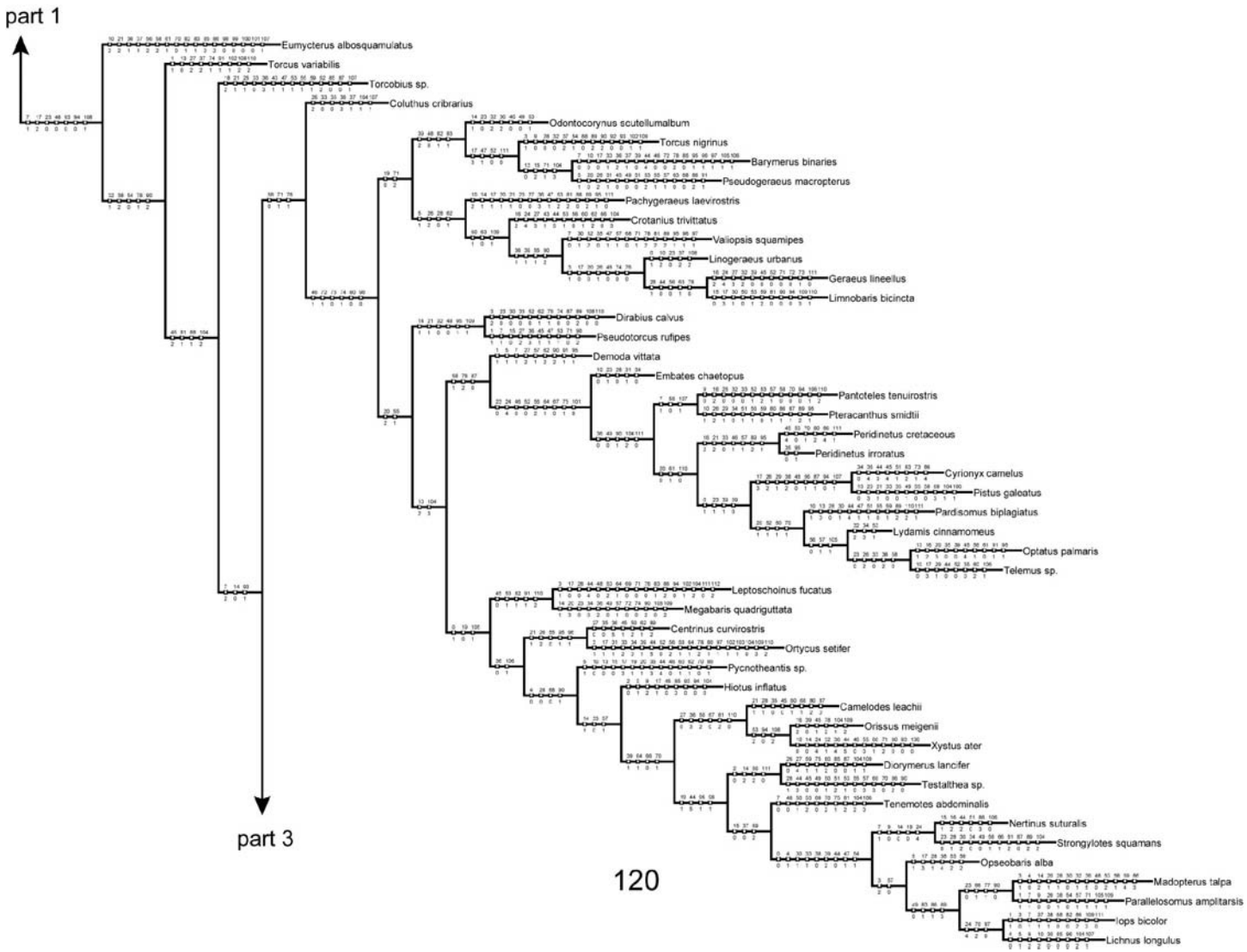

part 1
Eumycterus albosquamulatus
Torcus variabilis
Torcobius sp.
Coluthus cribrarius
Odontocorynus scutellumalbum
Torcus rigrinus
Barymerus binaries
Pseudogeraeus macropterus
Pachygeraeus laevirostris
Crotanius trivittatus
Valiopsis squampes
Linogeraeus urbanus
Geraeus lineellus
Limnobaris bicincta
Dirabius calvus
Pseudotorcus rufipes
Demoda vittata
Embates chaetopus
Pantoteles tenuirostris
Pteracanthus smictii
Peridinetus cretaceous
Peridinetus irroratus
Cyrionyx camelus
Pistus galeatus
Pardiscorus biplagiatus
Lydarris cinnarromeus
Optatus palmaris
Telemus sp.
Leptoschoinus fucatus
Megabaris quadriguttata
Centrinus curvirostris
Ortycus setifer
Pycnotheantis sp.
Hictus inflatus
Camelodes leachii
Orissus meigenii
Xystus ater
Diorymerus lancifer
Testalthea sp.
Tenemotes abdominalis
Nertinus suturalis
Strongylotes squamans
Opseobaris alba
Madopterus talpa
Parallelosomus amplitarsis
Iops bicolor
Lichnus longulus
part 3
119

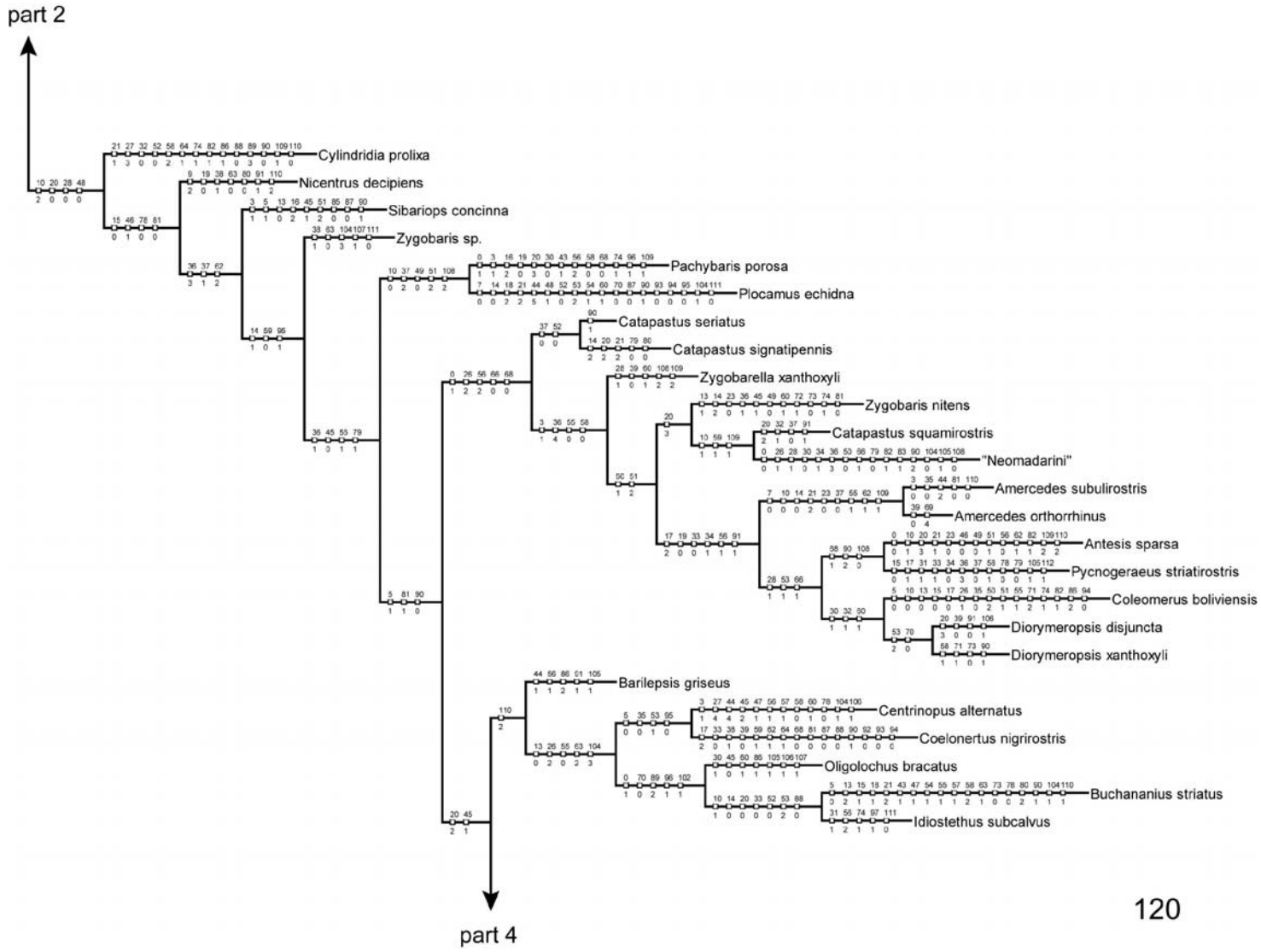

part 2
Cylindridia prolixa
Nicentrus decipiens
Sibariops concinna
Zygobaris sp.
Pachybaris porosa
Plocamus echidna
Catapastus seriatus
Catapastus signatipennis
Zygobarella xanthoxyli
Zygobaris nitens
Catapastus squamirostris
"Neomadarini"
Amercedes subulirostris
Amercedes orthorrhinus
Antesis sparsa
Pycnogeraeus striatirostris
Coleomerus boliviensis
Diorymeropsis disjuncta
Diorymeropsis xanthoxyli
Barilepsis griseus
Centrinopus alternatus
Coelonertus nigrirostris
Oligolochus bracatus
Buchananius striatus
Idiostethus subcalvus
part 4

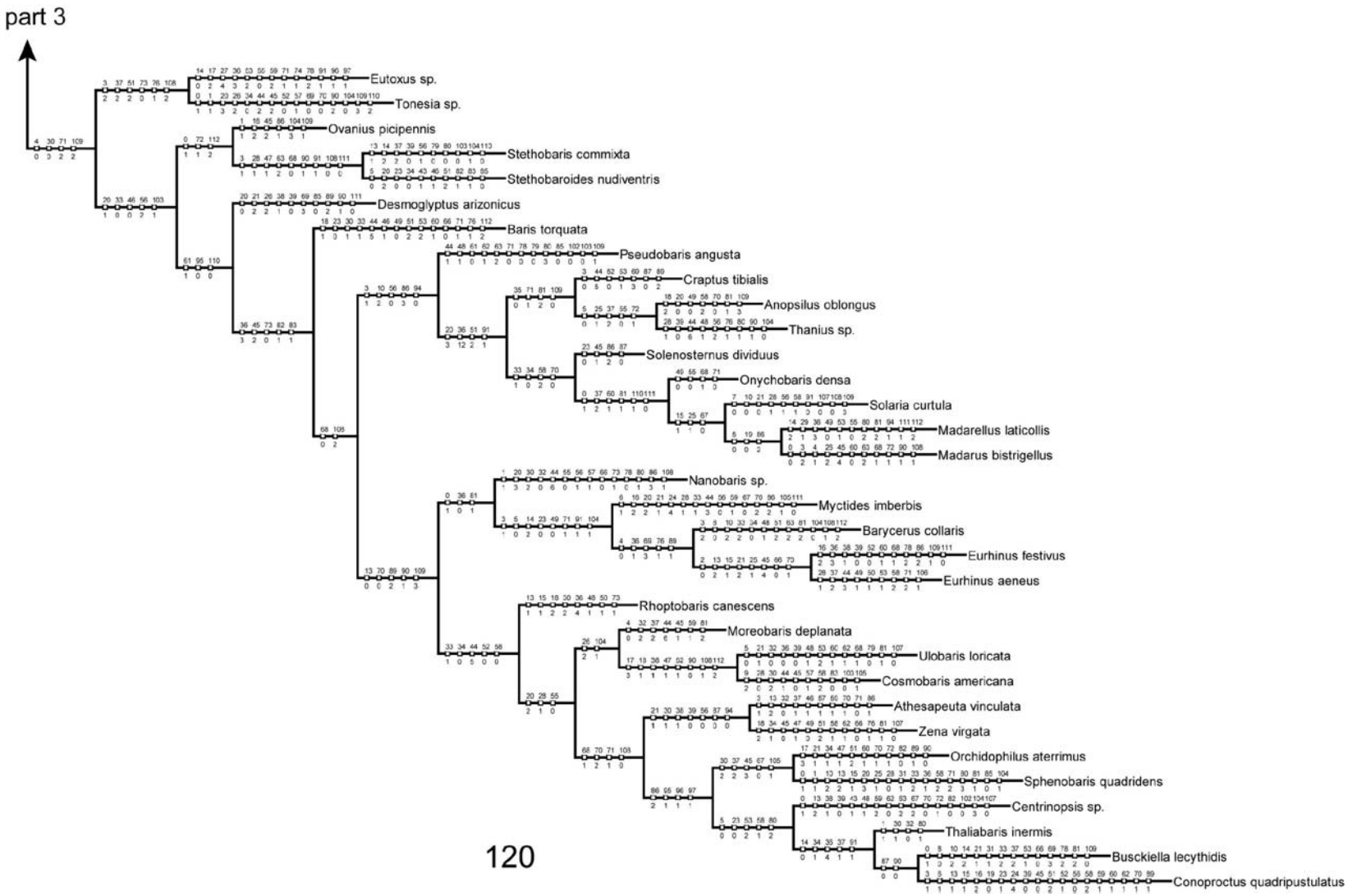
part 3


Eutoxus sp.
Tonesia sp.
Ovarius picipennis
Stethobaris commixta
Stethobaroides nudiventris
Desmoglyptus arizonicus
Baris torquata
Pseudobaris angusta
Craptus tibialis
Anopsilus oblongus
Thanius sp.
Solenosternus dividuus
Onychobaris densa
Solaria curtula
Madarellus laticollis
Madarus bistrigellus
Nanobaris sp.
Myctides imberbis
Barycerus collaris
Eurhinus festivus
Eurhinus aeneus
Rhoptobaris canescens
Morecobaris deplanata
Ulobaris loricata
Cosmobaris americana
Athesapeuta vinculata
Zena virgata
Orchidophilus aterrimus
Sphenobaris quadridens
Centrinopsis sp.
Thaliabaris inermis
Buskiella lecythidis
Conoproctus quadripustulatus


Dryophthorinae (Dryophthorus americanus)
Entiminae (Cyrtepistomus castanaeus)
Bagoinae (Bagous transversus)
Curculioninae (Curculio pardalis)
Cryptorhynchinae (Cryptorhynchus lapathi)
Metialma straminea
Trigonocolus curvipes
Molytinae (Conotrachelus fissunguis)
Mecopus trilineatus
Balanogastris kolae
Telephae oculata
Molytinae (Cholus rana)
Trichodocerus sp.
Cyllophorus fausciatus
Acoptus suturalis
Cylindrocopturus adspersus
Lobotrachelus troglodytes
Hypurus bertrandi
Phytobius oriseomicans
Auleutes argentinensis
Mononychus vulpeculus
Coeliodes flavicaudis
Ceutorhynchinae (Ceutorhynchus obstrictus)
Conoderinae (Cylindrocopturus operculatus)
Parorobitis gibbus
Derelominae (Derelomus basalis)
Arachnopus gazella
Microcholus puncticollis
Eisonyx crassipes
Barilepton filiforme
Barilepton quadrieolle
Barinus bivittatus
Barinus cribricollis
Centrinogyna hispidula
Centrinogyna strigata
part 2

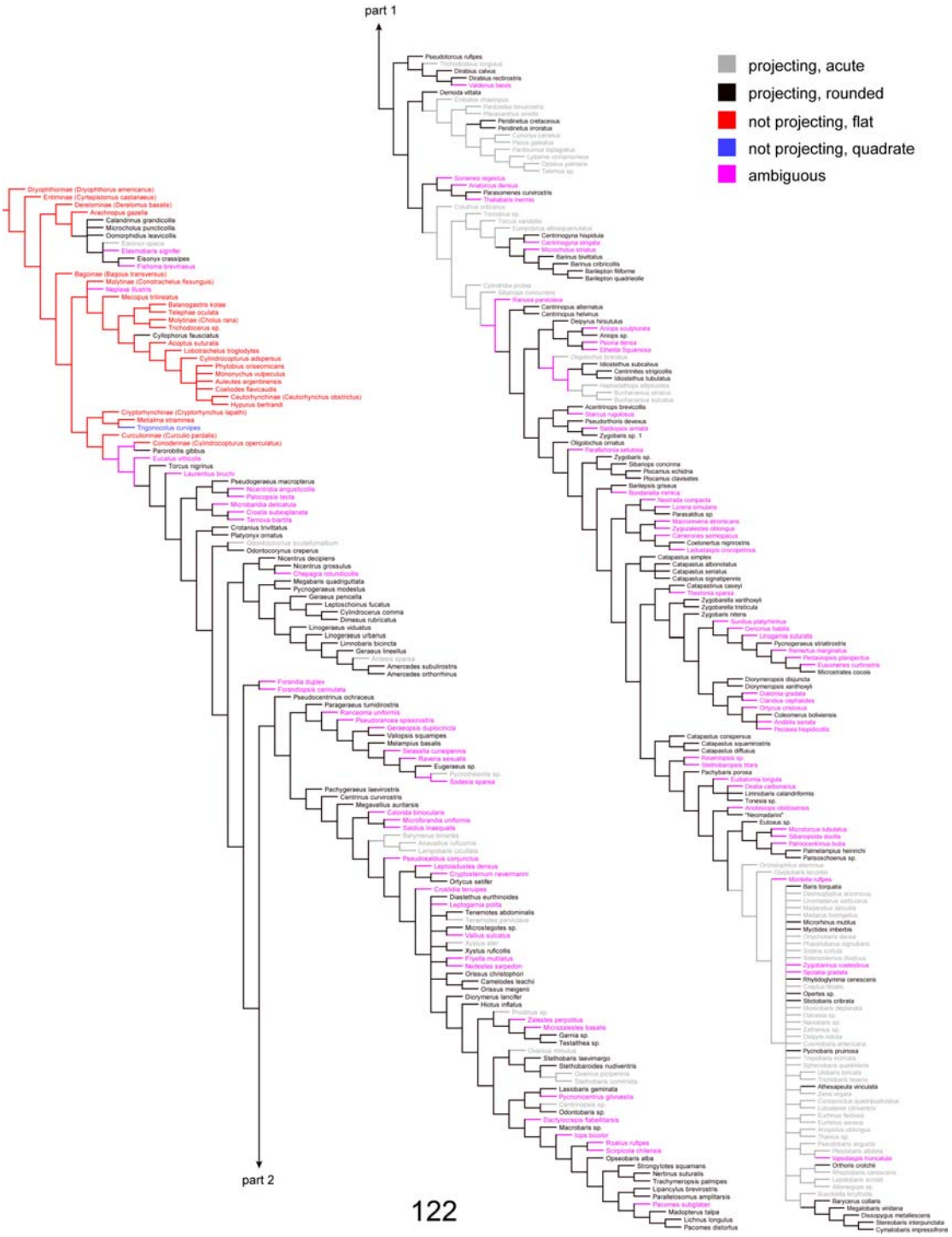

part 1
Eumycterus albosquamulatus
Torcus variabilis
Torcobius sp.
Coluthus cribrarius
Odontocorynus scutellumalbum
Torcus nigrinus
Barymerus binaries
Pseudogeraeus macropterus
Pachygeraeus laevirostris
Crotanius trivittatus
Valiopsis squamipes
Linogeraeus urbanus
Geraeus lineellus
Limnobaris bicincta
Dirabius calvus
Pseudotorcus rufipes
Demoda vittata
Embates chaetopus
Pantoteles tenuirostris
Pteracanthus smidtii
Peridinetus cretaceous
Peridinetus irroratus
Cyrionyx camelus
Pistus galeatus
Pardisomus biplagiatus
Lydamis cinnamomeus
Optatus palmaris
Telemus sp.
Leptoschoinus fucatus
Megabaris quadriguttata
Centrinus curvirostris
Ortycus setifer
Pycnotheantis sp.
Hiotus inflatus
Camelodes leachii
Orissus meigenii
Xystus ater
Diorymerus lancifer
Testalthea sp.
Tenemotes abdominalis
Nertinus suturalis
Strongylotes squamans
Opseobaris alba
Madopterus talpa
Parallelosomus amplitarsis
Iops bicolor
Lichnus longulus
part 3
120


part 2
Cylindridia prolixa
Nicentrus decipiens
Sibariops concinna
Zygobaris sp.
Pachybaris porosa
Plocamus echidna
Catapastus seriatus
Catapastus signatipennis
Zygobarella xanthoxyli
Zygobaris nitens
Catapastus squamirostris
"Neomadarini"
Amercedes subulirostris
Amercedes orthorrhinus
Antesis sparsa
Pycnogeraeus striatirostris
Coleomerus boliviensis
Diorymeropsis disjuncta
Diorymeropsis xanthoxyli
Barilepsis griseus
Centrinopus alternatus
Coelonertus nigrirostris
Oligolochus bracatus
Buchananius striatus
Idiostethus subcalvus
part 4

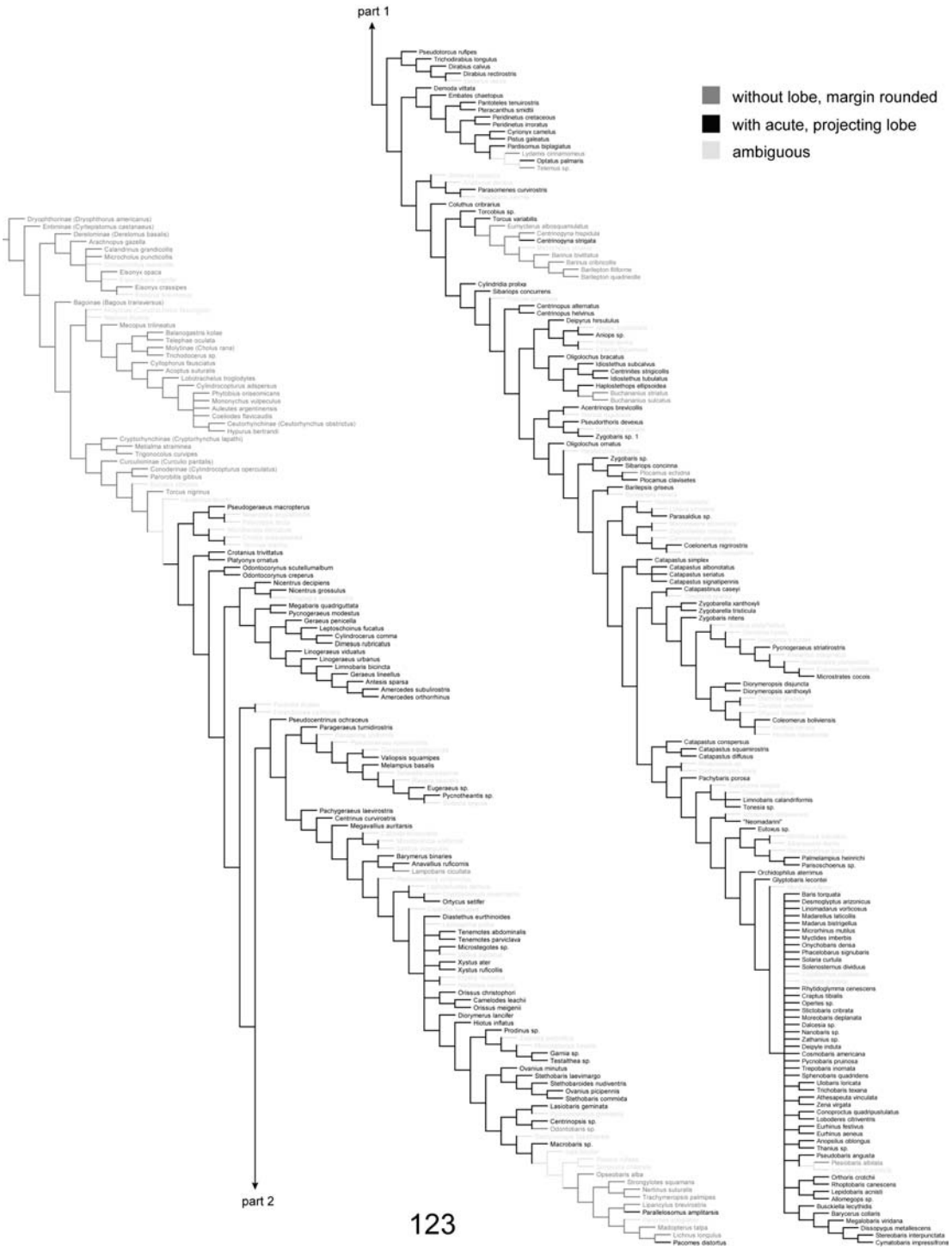

part 3
Eutoxus sp.
Tonesia sp.
Ovanius picipennis
Stethobaris commixta
Stethobaroides nudiventris
Desmoglyptus arizonicus
Baris torquata
Pseudobaris angusta
Craptus tibialis
Anopsilus oblongus
Thanius sp.
Solenosternus dividuus
Onychobaris densa
Solaria curtula
Madarellus laticollis
Madarus bistrigellus
Nanobaris sp.
Myctides imberbis
Barycerus collaris
Eurhinus festivus
Eurhinus aeneus
Rhoptobaris canescens
Moreobaris deplanata
Ulobaris loricata
Cosmobaris americana
Athesapeuta vinculata
Zena virgata
Orchidophilus aterrimus
Sphenobaris quadridens
Centrinopsis sp.
Thaliabaris inermis
Busckiella lecythidis
Conoproctus quadripustulatus

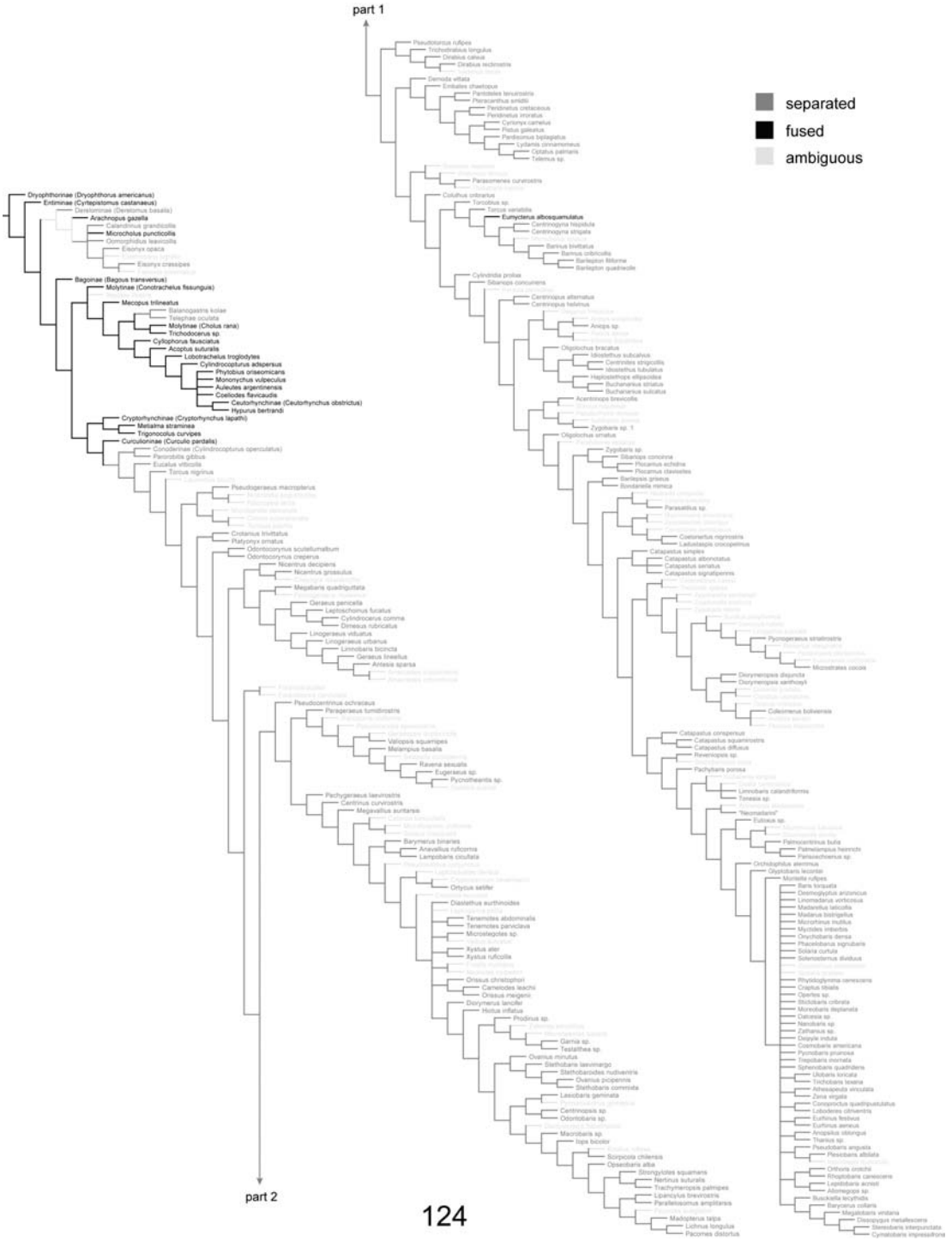

part 1
part 2
tergites heavily sclerotized
tergites lightly sclerotized
ambiguous

121

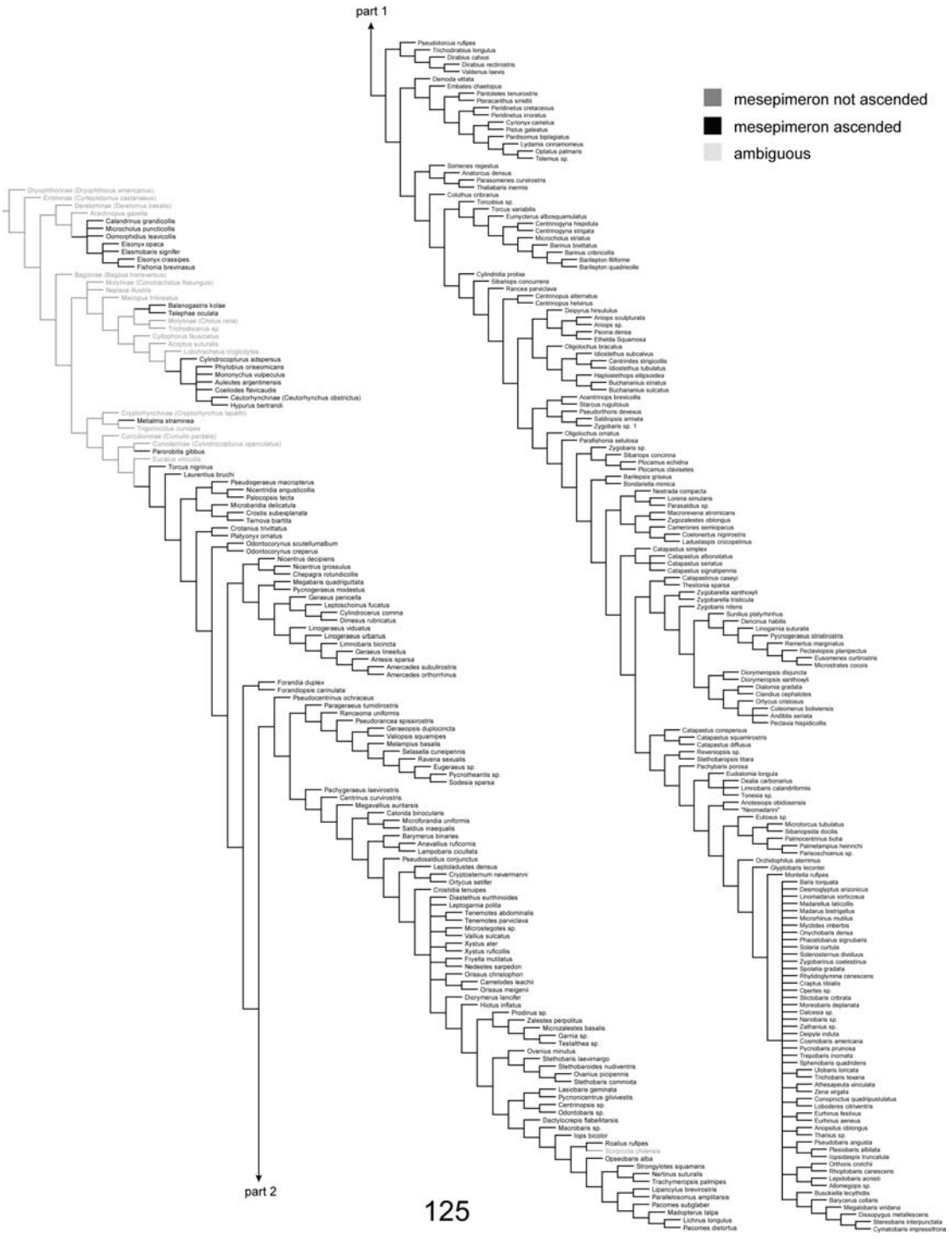

part 1
part 2
projecting, acute
projecting, rounded
not projecting, flat
not projecting, quadrate
ambiguous

122


part 1
without lobe, margin rounded
with acute, projecting lobe
ambiguous
part 2
123


part 1
part 2
separated
fused
ambiguous
Dryophthorinae (Dryophthorus americanus)
Entiminae (Cyrtepistomus castaneus)
Dryophthorinae (Dryophthorus americanus)
Entiminae (Cyrtepistomus castaneus)
Dereliominae (Derelomus basalis)
Arachnopus gazella
Calandrinus grandicollis
Microcholus puncticollis
Otiorrophidius leavicollis
Eisonyx opaca
Eisonyx crassipes
Bagoinae (Bagous transversus)
Molytinae (Conotrachelus fissunguis)
Mecopus trilineatus
Balanogastris kolae
Telephae oculata
Molytinae (Cholus rana)
Trichodocerus sp.
Cyllophorus fasciatus
Acoptus suturalis
Lobotrachelus troglodytes
Cylindrocopturus adspersus
Phytobius oriseomicans
Mononychus vulpeculus
Auleutes argentinensis
Coeliodes flavicaudis
Ceutorhynchinae (Ceutorhynchus obstrictus)
Hypurus bertrandi
Cryptorhynchinae (Cryptorhynchus lapathi)
Metialma straminea
Trigonocolus curvipes
Curculioninae (Curculio pardalis)
Conoderinae (Cylindrocopturus operculatus)
Peiorostola gibbus
Eucalus viticollis
Torcus nigrinus
Pseudogeraeus macropterus
Crotanius trivittatus
Platyonyx ornatus
Odontocorynus scutellumalbum
Odontocorynus creperus
Nicentrus decipiens
Nicentrus grossulus
Megabaris quadriguttata
Geraeus penicella
Leptoschoinus fucatus
Cylindrocerus comma
Orneaus rubricatus
Linogeraeus villuatus
Linogeraeus urbanus
Limobaris bicincta
Geraeus lineellus
Antesia sparsa
Pseudocentrinus ochraceus
Paregeraeus tumitirostris
Valiopsis squamipes
Melampus basalis
Ravena sexualis
Eugeraeus sp.
Pycnotheantis sp.
Pachygeraeus laevirostris
Centrinus curvirostris
Megavalius auritarsis
Barymerus binaries
Anevalius ruficornis
Lamprobaris cicultata
Ortycus setifer
Diastethus eurthinoides
Tenemotes abdominalis
Tenemotes paniculava
Microstegotes sp.
Aystus alter
Aystus ruficollis
Orisaus christophori
Cameloides leachi
Orisaus integenis
Dioryrnerus lanofer
Hoitus inflatus
Prodinus sp.
Garnia sp.
Testalthea sp.
Ovalnius monutus
Stethobaris laevimargo
Stethobaroides nudiventris
Ovalnius picipennis
Stethobaris commista
Lasiobaris geminata
Centrinopsis sp.
Odontobaris sp.
Macrobaris sp.
Iopa bicolor
Scopicola chilensis
Opsiobaris alba
Stongylotes squamans
Nertinus suturalis
Trachymerpsis palmipes
Lipanculus brevirostris
Paratelosomus amplitarsis
Madopterus talpa
Lichnus longulus
Pacornes distortus
Eurycleras albosquamulatus
Centrinogyna hispidula
Centrinogyna striqata
Barinus bivittatus
Barinus orbicollis
Barleppion filiforme
Barleppion quadrisetis
Cylindrida prolixa
Sibariops concinnens
Centrinopus alternatus
Centrinopus helvinus
Anoips sp.
Oligolochus bracatus
Idiostethus subcalvus
Centrinites strigicollis
Idiostethus tuberatus
Haplostethops ellipsoidea
Buchanarius striatus
Buchanarius sulcatus
Acentropus brevicollis
Zygobaris sp. 1
Oligolochus srnatus
Zygobaris sp.
Sibariops concinna
Plocamus echidna
Plocamus clavisetes
Barleppis griseus
Bondarella mimica
Parasellus sp.
Coelonertus nigrirostris
Ladusiasplis crocopelmus
Catapastus simplex
Catapastus albonotatus
Catapastus seriatus
Catapastus signatipennis
Pycnogeraeus striatirostris
Microstrates cocos
Dioryrneropsis disjuncta
Dioryrneropsis xanthosyi
Coleomerus bolivianis
Catapastus conspersus
Catapastus squamirostris
Catapastus diffusus
Revenopsis sp.
Pachybaris porosa
Limnobaris calandriformis
Tonesia sp.
"Neomalarini"
Eubious sp.
Palmocentrinus bulia
Palmelampus heinrichi
Parausechnenus sp.
Orchidophilus aterrimus
Glyptobaris lecontei
Myrtele rufipes
Baris torquata
Desmoglyptus anzonicus
Lixomadarus vorticosus
Madarellus laticollis
Madarus bistrigellus
Microthinus multus
Myctides imbarbis
Onychobaris dentsa
Phaceobbarus signubaris
Solaris curtula
Solenostermus dubiosus
Rhyridoglymma cerescens
Craptus tibialis
Operites sp.
Stictobaris cribrata
Moreobaris stepianata
Datrenia sp.
Nanobaris sp.
Zatharius sp.
Delayle indula
Cosmobaris americana
Pycnobaris pruinosa
Trepobaris inornata
Sphenobaris quadridens
Ulobaris lonicata
Trichobaris texana
Atheasapeuta vinculata
Zena virgata
Conapiocius quadripustulatus
Lobederes obliventris
Eurhinus festivus
Eurhinus aeneus
Anopsilus obtongus
Thanius sp.
Pseudobaris angusta
Pesobaris albilata
Orthoris crotchi
Rhoptobaris canescens
Lepidobaris acnisi
Abomegops sp.
Buskiella lecythdis
Baryceras collaris
Magiabaris viridans
Diasopygus metallescens
Stereobaris interpunctata
Cymatobaris impressithora

124


part 1
part 2
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mesepimeron ascended
ambiguous
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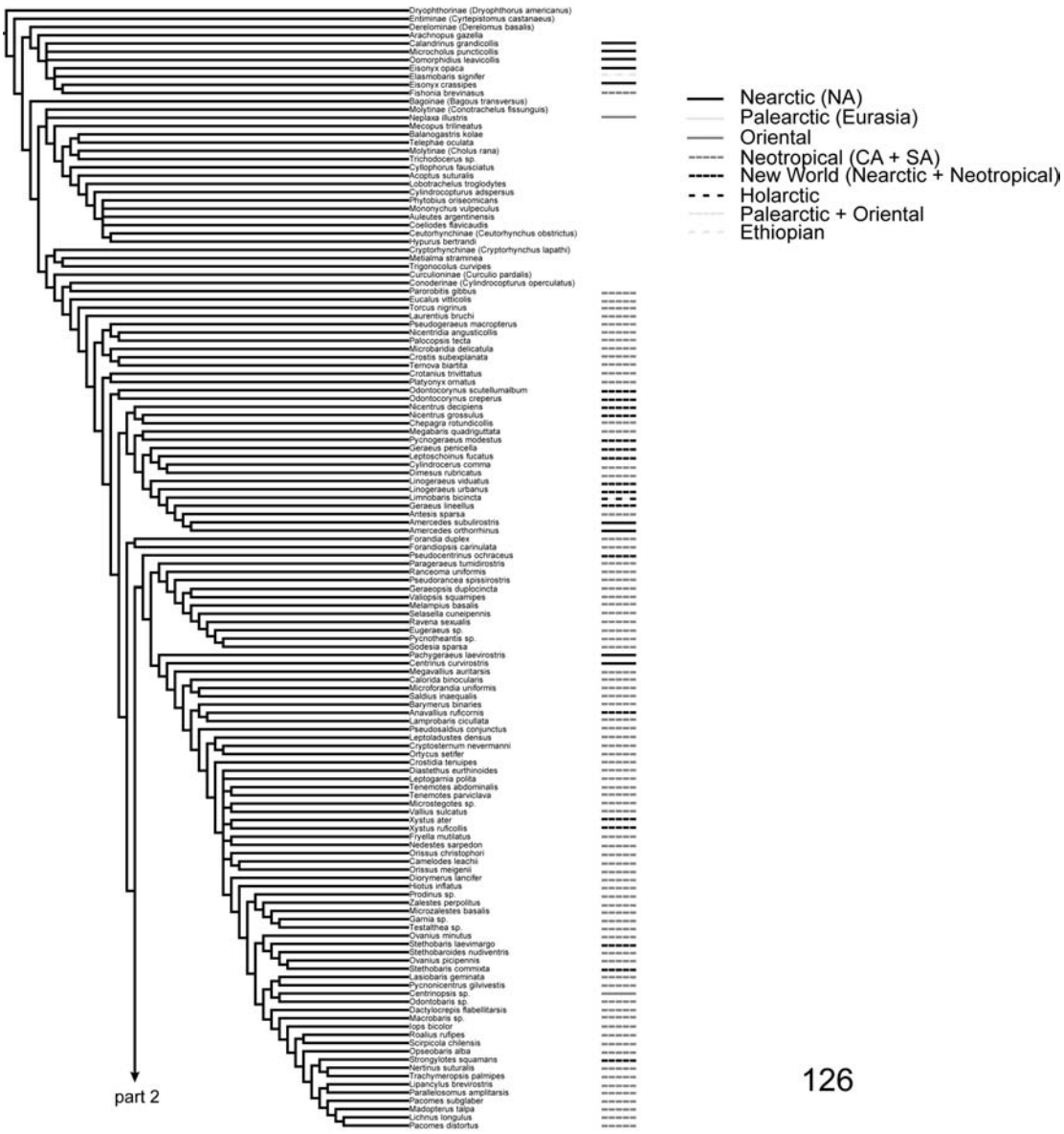
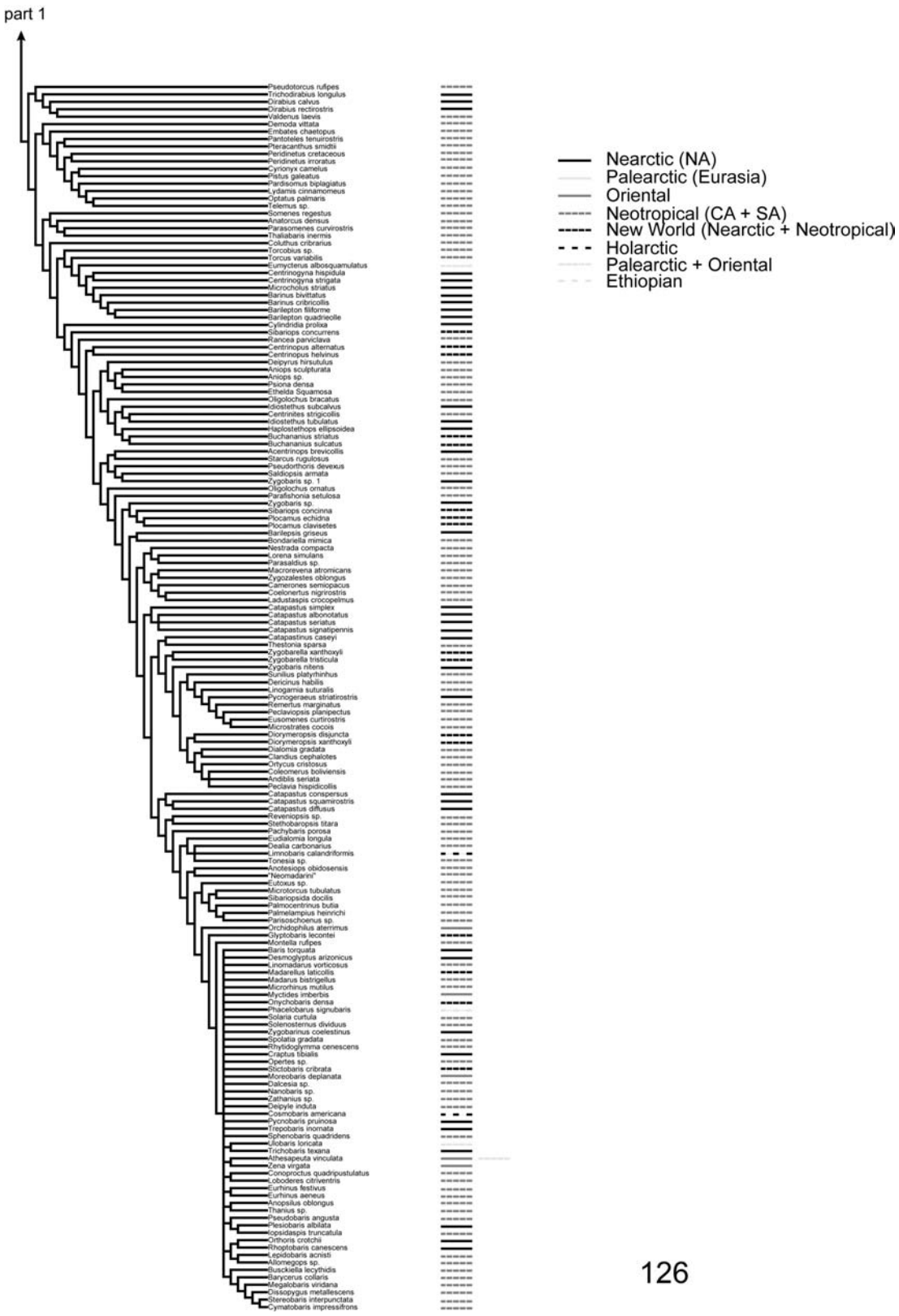
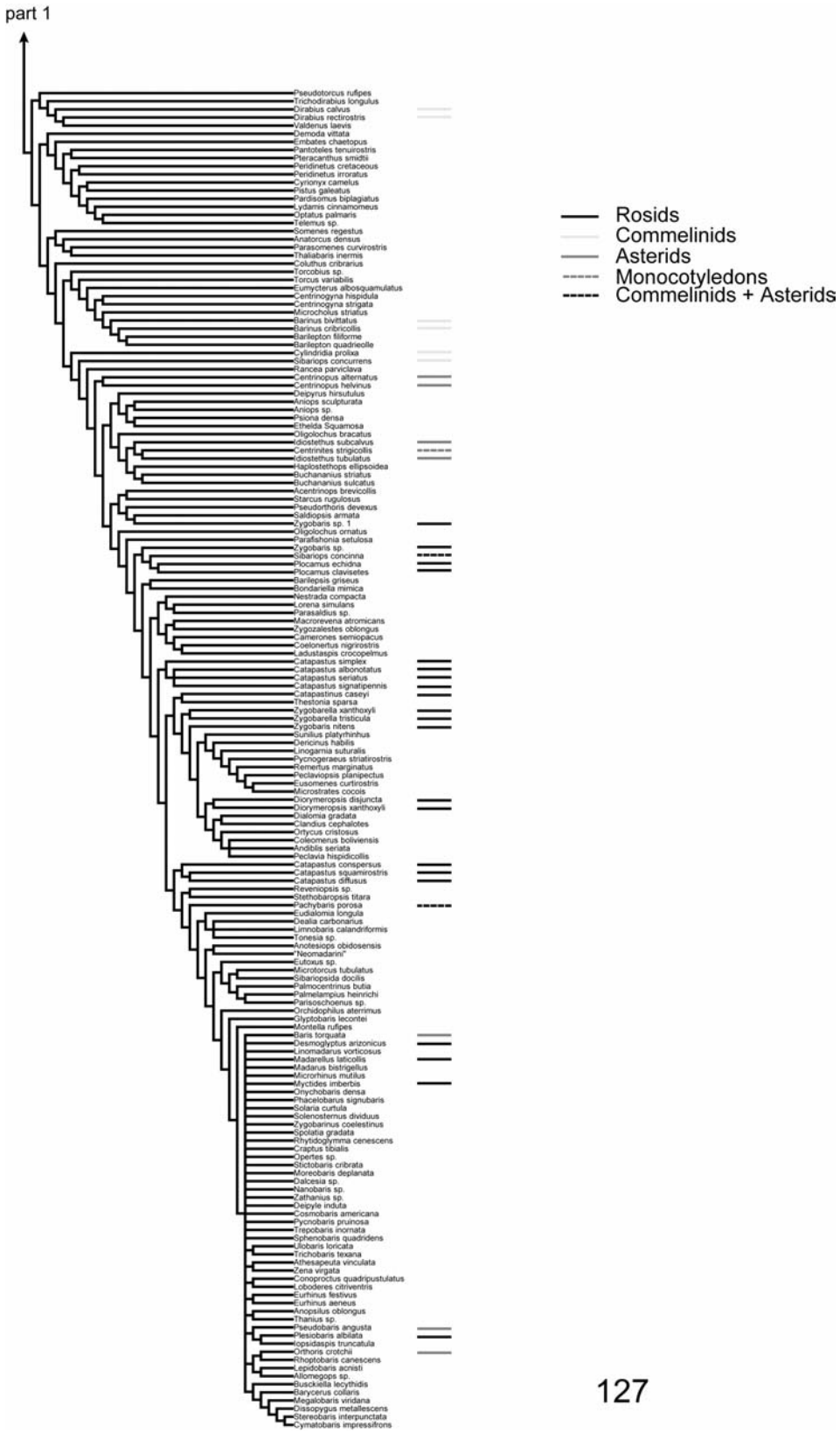
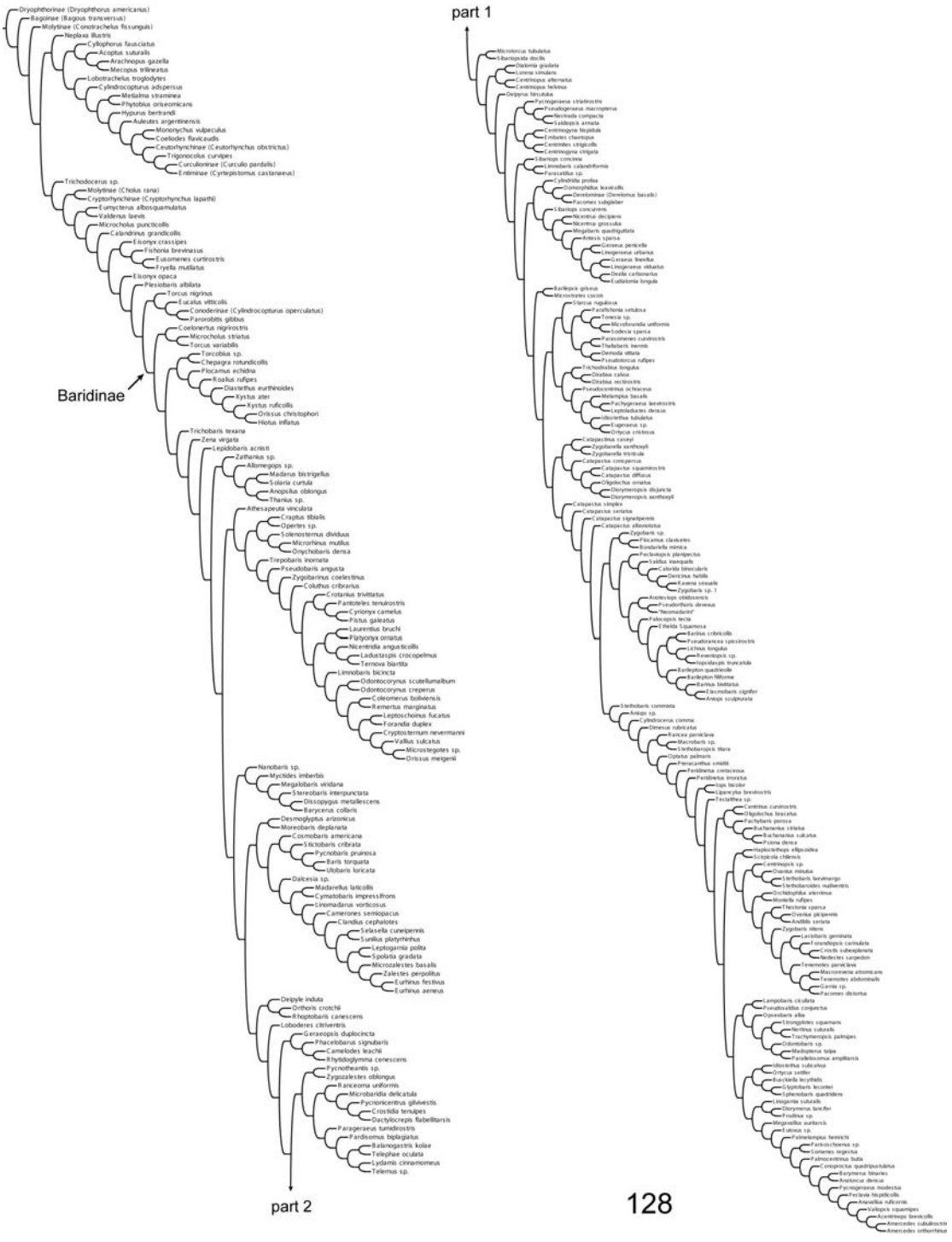

Dryophthorinae (Dryophthorus americanus)
Entiminae (Cyrtepistomus castaneus)
Dereleominae (Derelomus basalis)
Arachnopus gazella
Calandrinus grandicollis
Microcholus puncticollis
Oomorphidius leavicollis
Eisonyx opaca
Elasmobaris signifer
Eisonyx crassipes
Fahonia brevinasus
Bagoinae (Bagous transversus)
Molytinae (Conotrachelus fissunguis)
Neplaxa illustris
Mecopus trilineatus
Balanogastris kolae
Telephae oculata
Molytinae (Cholus rana)
Trichodocerus sp.
Cyllophorus fausciatus
Acoptus suturalis
Lobotrachelus troglodytes
Cylindrocopturus adspersus
Phytobius oriseomicans
Mononychus vulpeculus
Auleutes argentinensis
Coeliodes flavicaudis
Ceutorhynchinae (Ceutorhynchus obstrictus)
Hypurus bertrandi
Cryptorhynchinae (Cryptorhynchus lapathi)
Metialma straminea
Trigonocolus curvipes
Curculioninae (Curculio pardalis)
Conoderinae (Cylindrocopturus operculatus)
Pararobitis gibbus
Eucalus viticolis
Torcus nigrinus
Laurentius bruchi
Pseudogeraeus macropterus
Nicentridia angusticollis
Palocopsis tecta
Microbaridia delicatula
Crostis subexplanata
Ternova biartita
Crotanius trivittatus
Platyonyx ornatus
Odontocorynus scutellumalbum
Odontocorynus creperus
Nicentrus decipiens
Nicentrus grosulus
Chepagra rotundicollis
Megabaris quadriguttata
Pycnogeraeus modestus
Geraeus penicella
Leptoschoinus fucatus
Cylindrocerus comma
Dimesus rubricatus
Linogeraeus viduatus
Linogeraeus urbanus
Limnobaris bicincta
Geraeus lineellus
Antesis sparsa
Amercedes subulirostris
Amercedes orthorhinus
Forandia duplex
Forandiopsis carinulata
Pseudocentrinus ochraceus
Parageraeus tumidirostris
Ranceoma uniformis
Pseudorancea spissirostris
Geraeopsis duplocincta
Valiopsis squamipes
Metampius basalis
Selasella cuneipennis
Ravena sexualis
Eugeraeus sp.
Pycnotheantis sp.
Sodesia sparsa
Pachygeraeus laevirostris
Centrinus curvirostris
Megavallius auritarsis
Calorida binocularis
Microforandia uniformis
Saldius inaequalis
Barymerus binaries
Anavallius ruficornis
Lamprobaris ciculata
Pseudosaldius conjunctus
Leptoladustes densus
Cryptosternum nevermanni
Ortycus setifer
Crostidia tenuipes
Diastethus eurthinoides
Leptogamia polita
Tenemotes abdominalis
Tenemotes parviclava
Microstegotes sp.
Vallius sulcatus
Xystus ater
Xystus ruficollis
Fryella mutilatus
Nedestes sarpedon
Orissus christophori
Camelodes leachii
Orissus meigenii
Dioprymerus lancifer
Hiotus inflatus
Prodinus sp.
Zalestes perpolitus
Microzalestes basalis
Garnia sp.
Testalthea sp.
Ovanius minutus
Stethobaris laevimargo
Stethobaroides nudiventris
Ovanius picipennis
Stethobaris commixta
Lasiobaris geminata
Pycnonicentrus gilvivestis
Centrinopsis sp.
Odontobaris sp.
Dactylocrepis flabellitarsis
Macrobaris sp.
Iops bicolor
Rosalius rufipes
Scripicola chilensis
Opseobaris alba
Strongylotes squamans
Nertinus suturalis
Trachymeropsis palmipes
Lupancylus brevirostris
Parallelosomus amplitarsis
Pacomes subglaber
Madopterus talpa
Lichnus longulus
Pacomes distortus
part 2
Nearctic (NA)
Palearctic (Eurasia)
Oriental
Neotropical (CA + SA)
New World (Nearctic + Neotropical)
Holarctic
Palearctic + Oriental
Ethiopian

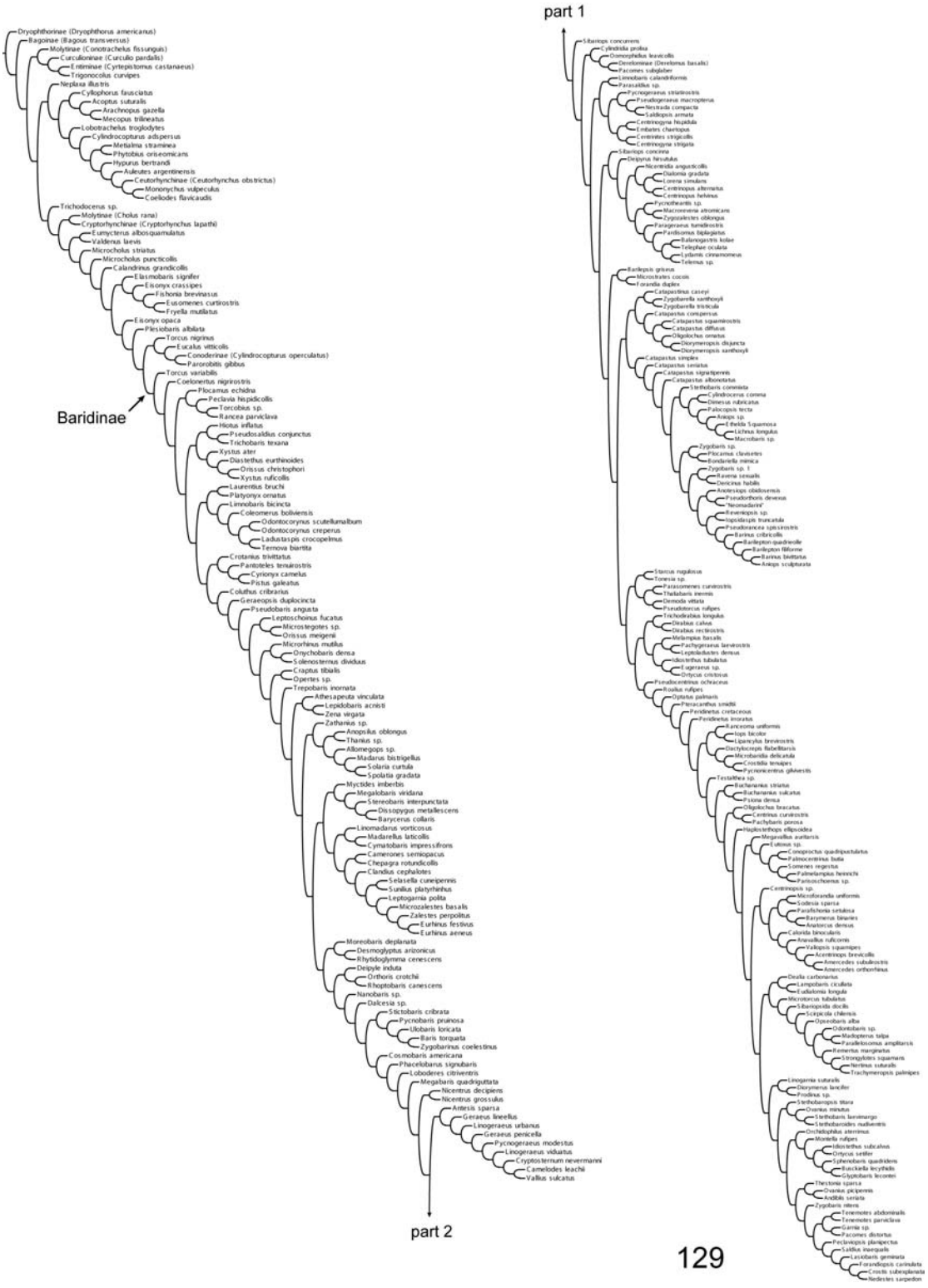
126

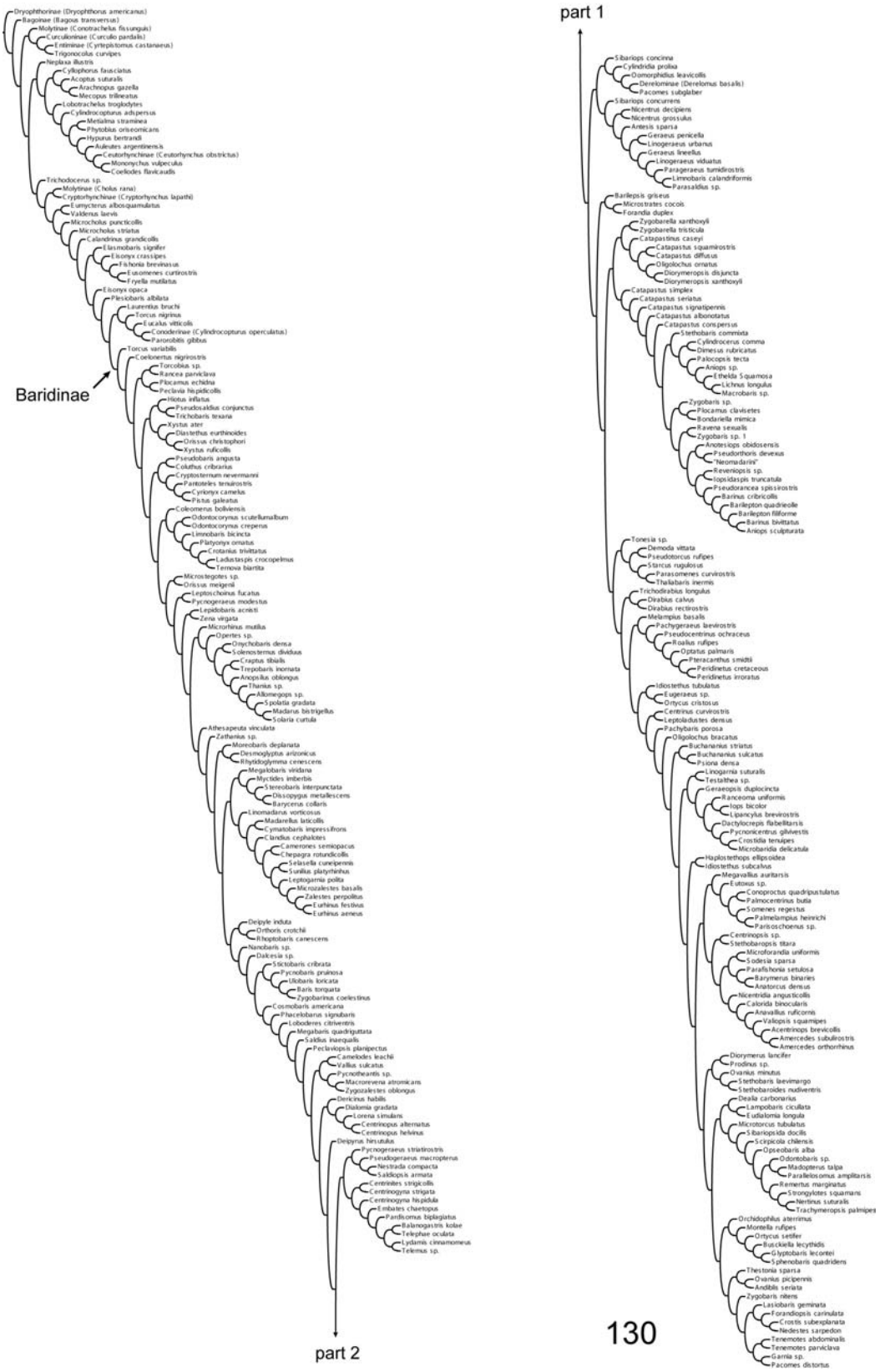

part 1
Pseudotorcus rufipes
Trichodirabius longulus
Dirabius calvus
Dirabius rectirostris
Valdenus laevis
Oemoda vittata
Embates chaetopus
Pantoteles tenuirostris
Peracanthus smidti
Peridinetus cretaceous
Peridinetus irroratus
Cyrionyx camelus
Pistus galeatus
Pardisomus biplagiatus
Lydamis cinnamomeus
Optatus palmaris
Telemus sp.
Somenes regestus
Anatorcus densus
Parasomenes curvirostris
Thaliabaris inermis
Coluthus cribrarius
Torcobius sp.
Torcus variabilis
Eumycterus albosquamulatus
Centrinogyna hispidula
Centrinogyna strigata
Microcholus striatus
Barinus bivittatus
Barinus cribricollis
Barilepton filiforme
Barilepton quadrisetile
Cylindridia prolixa
Sibariops concurrens
Rancea parviclava
Centrinopus alternatus
Centrinopus helvinus
Deipyrus hirsutulus
Aniops sculpturata
Aniops sp.
Psiona densa
Ethelda Squamosa
Oligolochus bracatus
Idiostethus subcalvus
Centrinites strigicollis
Idiostethus tubulatus
Haplostethops ellipsoidea
Buchananius striatus
Buchananius sulcatus
Acentrinops brevicollis
Starcus rugulosus
Pseudorthoris devexus
Saldiopsis armata
Zygobaris sp. 1
Oligolochus ornatus
Parafishonia setulosa
Zygobaris sp.
Sibariops concinna
Plocamus echidna
Plocamus clavisetes
Barilepsis griseus
Bondariella mimica
Nestrada compacta
Lorena simulans
Parasaldius sp.
Macrorevena atromicans
Zygozalestes oblongus
Camerones semiopacus
Coelonertus nigrirostris
Ladustaspis crocopelmus
Catapastus simplex
Catapastus albonotatus
Catapastus seriatus
Catapastus signatipennis
Catapastinus caseyi
Thestonia sparsa
Zygobarella xanthoxyli
Zygobarella tristicula
Zygobaris nitens
Sunilius platyrhinhus
Dericirus habilis
Linogarnia suturalis
Pycnogeraeus striatirostris
Remertus marginatus
Peclaviopsis planipectus
Eusomenes curtirostris
Microstrates cocois
Diorymeropsis disjuncta
Diorymeropsis xanthoxyli
Dialomia gradata
Clandius cephalotes
Orthycus cristosus
Coleomerus boliviensis
Andibilis seriata
Peclavia hispidicollis
Catapastus conspersus
Catapastus squamirostris
Catapastus diffusus
Reveniopsis sp.
Stethobaropsis titara
Pachybaris porosa
Eudialomia longula
Dealia carbonarius
Limnobaris caliandriformis
Tonesia sp.
Anotesiops obidosensis
"Neomadarini"
Eutoxus sp.
Microtorcus tubulatus
Sibariopsida docilis
Palmocentrinus butia
Palmelampius heinrichi
Parisoschoenus sp.
Orchidophilus aterrimus
Glyptobaris lecontei
Montella rufipes
Baris torquata
Desmoglyptus arizonicus
Linomadarus vorticosus
Madarellus laticollis
Madarus bistrigellus
Microrhinus mutilus
Myctides imberbis
Onychobaris densa
Phacelobarus signubaris
Solaria curtula
Solenosternus dividuus
Zygobarinus coelestinus
Spolatia gradata
Rhytidoglymma cenescens
Craptus tibialis
Opertes sp.
Stictobaris cribrata
Moreobaris deplanata
Dalcesia sp.
Nanobaris sp.
Zathanius sp.
Deipyle induta
Cosmobaris americana
Pycnobaris pruinosa
Trepobaris inornata
Sphenobaris quadridens
Liobaris loricata
Trichobaris texana
Athesapeuta vinculata
Zena virgata
Conoproctus quadripustulatus
Loboderes citriventris
Eurhinus festivus
Eurhinus aeneus
Anopsilus oblongus
Thanius sp.
Pseudobaris angusta
Plesiobaris albilata
Topsidaspis truncatula
Orthoris crotchii
Rhoptobaris canescens
Lepidobaris acnisti
Allomegops sp.
Buskiella lecythidis
Barycerus collaris
Megalobaris viridana
Dissopygus metallescens
Stereobaris interpunctata
Cymatobaris impressifrons
Nearctic (NA)
Palearctic (Eurasia)
Oriental
Neotropical (CA + SA)
New World (Nearctic + Neotropical)
Holarctic
Palearctic + Oriental
Ethiopian
126

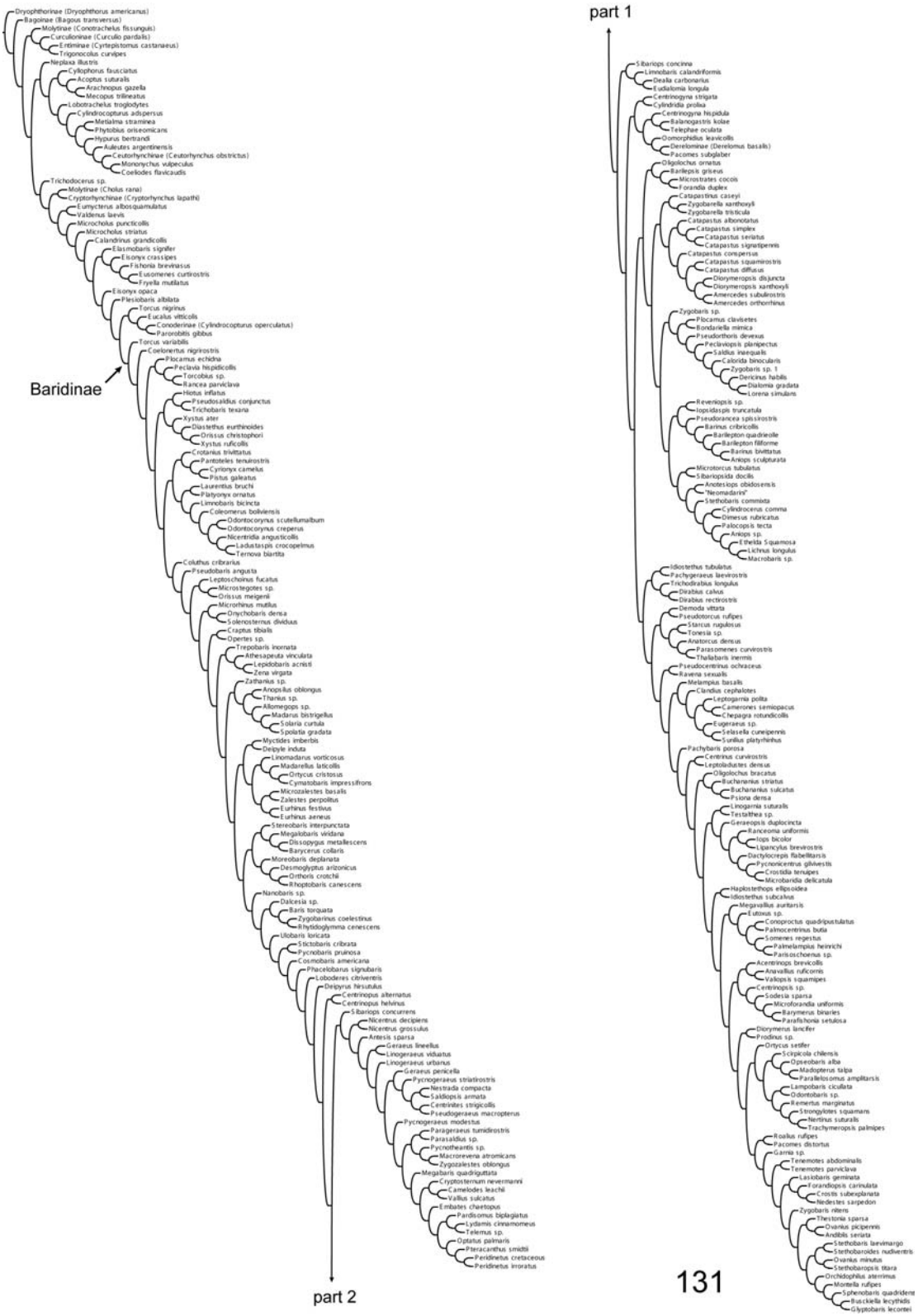

Dryophthorinae (Dryophthorus americanus)
Entiminae (Cyrtepistomus castanaeus)
Derelominae (Derelomus basalis)
Arachnopus gazella
Calandrinus grandicollis
Microcholus punctipennis
Oomorphidius leavicollis
Eisonyx opaca
Elasmobaris signifer
Eisonyx crassipes
Fishonia brevinasus
Bagoinae (Bagous transversus)
Molytinae (Conotrachelus fissunguis)
Neplaxa illustris
Mecopus trilineatus
Balanogastris kolae
Telephae oculata
Molytinae (Cholus rana)
Trichodocerus sp.
Cyllophorus fausciatus
Acoptus suturalis
Lobotrachelus troglodytes
Cylindrocopturus adspersus
Phytobius oriseomicans
Mononychus vulpeculus
Auleutes argentinensis
Coelolodes flavicaudis
Ceutorhynchinae (Ceutorhynchus obstrictus)
Hypurus bertrandi
Cryptorhynchinae (Cryptorhynchus lapathi)
Metialma straminea
Trigonocolus curvipes
Curculioninae (Curculio pardalis)
Conoderinae (Cylindrocopturus operculatus)
Parorobitis gibbus
Eucalus vitticolis
Torcus nigrinus
Laurentius bruchi
Pseudogeraeus macropterus
Nicentridia angusticollis
Palocopsis tecta
Microbaridia delicatula
Crostis subexplanata
Ternova biartita
Crotanius trivittatus
Platyonyx ornatus
Odontocorynus scutellumalbum
Odontocorynus creperus
Nicentrus decipiens
Nicentrus grossulus
Chegagra rotundicollis
Megabaris quadriguttata
Pycnogeraeus modestus
Geraeus penicella
Leptoschoinus fucatus
Cylindrocerus comma
Dimesus rubricatus
Linogeraeus viduatus
Linogeraeus urbanus
Limnobaris bicincta
Geraeus lineellus
Antesis sparsa
Amercedes subulirostris
Amercedes orthorrhinus
Forandia duplex
Forandiopsis carinulata
Pseudocentrinus ochraceus
Parageraeus tumidirostris
Rancecma uniformis
Pseudorancea spissirostris
Geraeopsis duplocincta
Valiopsis squamipes
Melampius basalis
Selasella cuneipennis
Ravena sexualis
Eugeraeus sp.
Pycnotheantis sp.
Sodesia sparsa
Pachygeraeus laevirostris
Centrinus curvirostris
Megavallius auritarsis
Calorida binocularis
Microforandia uniformis
Saldius inaequalis
Barymerus binaries
Anavallius ruficornis
Lamprobaris ciculata
Pseudosaldius conjunctus
Leptoladustes densus
Cryptosternum nevermanni
Ortycus setifer
Crostidia tenuipes
Diastethus eurthinoides
Leptogarnia polita
Tenemotes abdominalis
Tenemotes parviclava
Microstegotes sp.
Vallius sulcatus
Xystus ater
Xystus ruficollis
Fryella mutilatus
Nedestes sarpedon
Orissus christophori
Camelodes leachii
Orissus meigenii
Diorymerus lanciter
Hiotus inflatus
Prodinus sp.
Zalestes perpolitus
Microzalestes basalis
Garnia sp.
Testalthea sp.
Ovanius minutus
Stethobaris laevimargo
Stethobaroides nudiventris
Ovanius picipennis
Stethobaris commixta
Lasiobaris germinata
Pycnonicentrus gilvivestis
Centrinopsis sp.
Odontobaris sp.
Dactylocrepis flabellitarsis
Macrobaris sp.
Iops bicolor
Roalius rufipes
Scirpicola chilensis
Opseobaris alba
Strongylotes squamans
Nertinus suturalis
Trachymeropsis palmipes
Lipancylus brevirostris
Parallelosomus amplitarsis
Pacomes subglaber
Madopterus talpa
Uchnus longulus
Pacomes distortus
part 2
Rosids
Commelinids
Asterids
Monocotyledons
Commelinids + Asterids
127

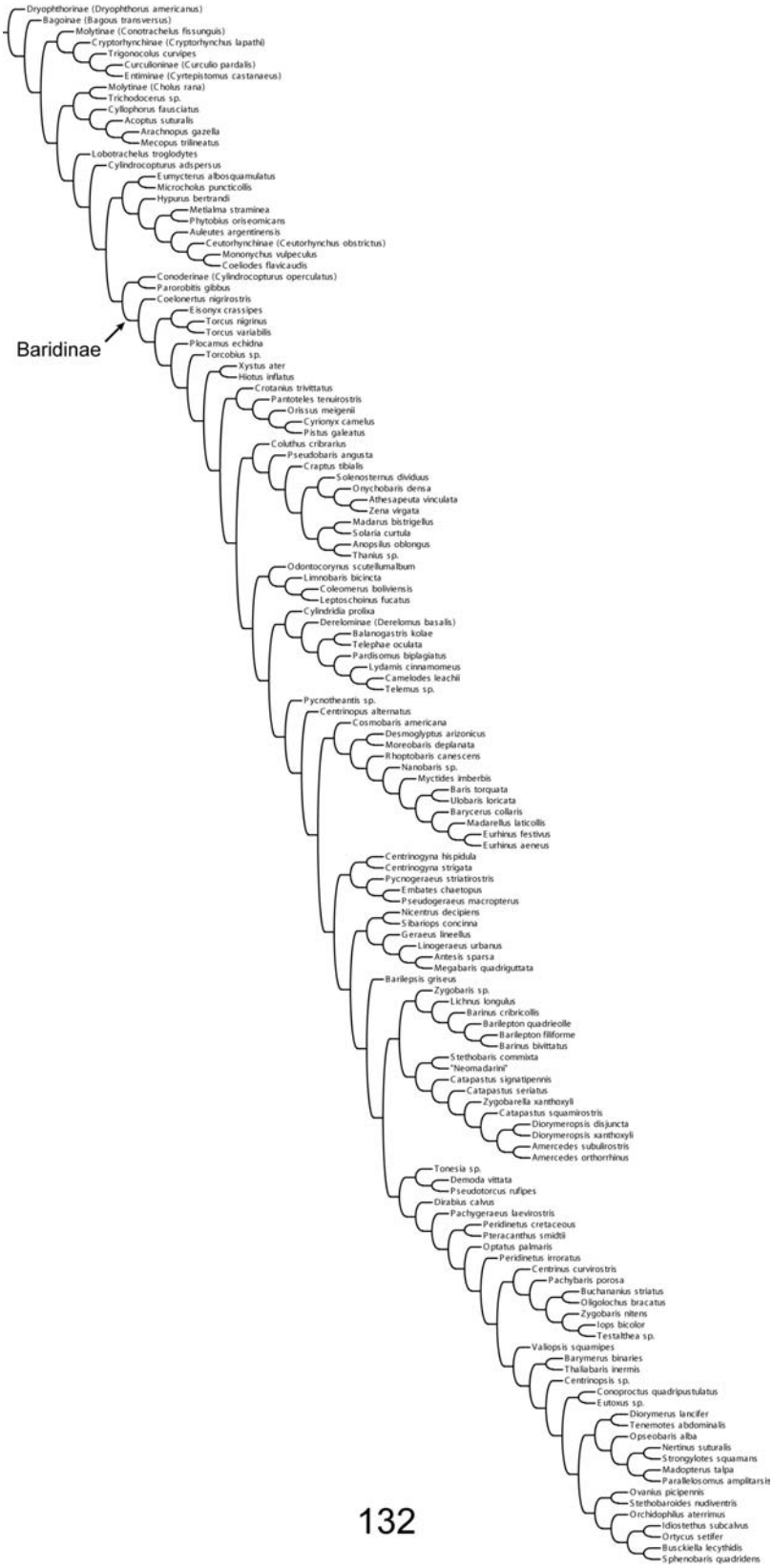

part 1
Pseudotorcus rufipes
Trichodirabius longulus
Dirabius callous
Dirabius rectirostris
Valdenus laevis
Demoda vittata
Embates chaetopus
Pantoteles tenuirostris
Pteracanthus smidtii
Peridinetus cretaceous
Peridinetus irroratus
Cyrionyx camelus
Pistus galeatus
Pardisomus biplagiatus
Lydamis cinnamomeus
Optatus palmaris
Telemus sp.
Somenes regestus
Anatorcus densus
Parasomenes curvirostris
Thaliabaris inermis
Coluthus cribrarius
Torcobius sp.
Torcus variabilis
Eumycterus albosquamulatus
Centrinogyna hispidula
Centrinogyna strigata
Microcholus striatus
Barinus bivittatus
Barinus cribricollis
Barilepton filiforme
Barilepton quadrieolle
Cylindridia prolixa
Sibariops concurrens
Rancea parviclava
Centrinopus alternatus
Centrinopus helvinus
Deipyrus hirsutulus
Aniops sculpturata
Aniops sp.
Psiona densa
Ethelda Squamosa
Oligolochus bracatus
Idiostethus subcalvus
Centrinites strigicollis
Idiostethus tubulatus
Haplostethops ellipsoidea
Buchananius striatus
Buchananius sulcatus
Acentrinops brevicollis
Starcus rugulosus
Pseudorthoris devexus
Saldopsis armata
Zygobaris sp. 1
Oligolochus ornatus
Parafishonia setulosa
Zygobaris sp.
Sibariops concinna
Plocamus echidna
Plocamus clavisetes
Barilepsis griseus
Bondariella mimica
Nestrada compacta
Lorena simulans
Parasaldius sp.
Macrorevena atromicans
Zygozalestes oblongus
Camerones semiopacus
Coelonertus nigrirostris
Ladustaspis croccopelmus
Catapastus simplex
Catapastus albonotatus
Catapastus seriatus
Catapastus signatipennis
Catapastinus caseyi
Thestonia sparsa
Zygobarella xanthoxyli
Zygobarella tristicula
Zygobaris nitens
Sunilius platythinhus
Dericinus habilis
Linogamia suturalis
Pycnogeraeus striatirostris
Remertus marginatus
Peclaviopsis planipectus
Eusomenes curtirostris
Microstrates cocois
Diorymeropsis disjuncta
Diorymeropsis xanthoxyli
Dialomia gradata
Clandius cephalotes
Drtycus cristosus
Colecmerus boliviensis
Andiblis seriata
Peclavia hispidicollis
Catapastus conspersus
Catapastus squamirostris
Catapastus diffusus
Reveniopsis sp.
Stethobaropsis titara
Pachybaris porosa
Eudialomia longula
Dealia carbonarius
Limnobaris calandriformis
Tonesia sp.
Anotesiops obidosensis
"Neomadarini"
Eutoxus sp.
Microtorcus tubulatus
Sibariopsida docilis
Palmocentrinus butia
Palmelampius heinrichi
Parisoschoenus sp.
Orchidophilus aterrimus
Glyptobaris lecontei
Montella rufipes
Baris torquata
Desmoglyptus arizonicus
Linomadarus vorticosus
Madarellus laticollis
Madarus bistrigellus
Microrhinus mutilus
Myctides imberbis
Onychobaris densa
Phacelobarus signubaris
Solaria curtula
Solenosternus dividuus
Zygobarinus coelestinus
Spolatia gradata
Rhytidoglymma cenescens
Craptus tibialis
Opertes sp.
Stictobaris cribrata
Moreobaris deplanata
Dalcesia sp.
Nanobaris sp.
Zathanius sp.
Deipyle induta
Cosmobaris americana
Pycnobaris pruinosa
Trepobaris inornata
Sphenobaris quadridens
Globaris loricata
Trichobaris texana
Mthesapeuta vinculata
Zena virgata
Conoproctus quadripustulatus
Loboderes citriventris
Eurhinus festivus
Eurhinus aeneus
Anopsilus oblongus
Thanius sp.
Pseudobaris angusta
Plesiobaris albilata
Topsidaspis truncatula
Orthoris crotchii
Rhoptobaris canescens
Lepidobaris acnisti
Allomegops sp.
Buscketia lecythidis
Baryceros collaris
Megalobaris viridana
Dissopygus metallescens
Stereobaris interpunctata
Cymatobaris impressifrons
Rosids
Commelinids
Asterids
Monocotyledons
Commelinids + Asterids
127


part 1
Baridinae
part 2
128


part 1
Baridinae
part 2
129


Baridinae
part 1
part 2
130


Baridinae
part 1
part 2
131


Dryophthorinae (Dryophthorus americanus)
Bagoinae (Bagous transversus)
Molytinae (Conotrachelus fissunguis)
Cryptorhynchinae (Cryptorhynchus lapathi)
Trigonocolus curvipes
Curculioninae (Curculio pardalis)
Entiminae (Cyrtepistomus castanaeus)
Molytinae (Cholus rana)
Trichodocerus sp.
Cyllophorus fausclatus
Acoptus suturalis
Arachnopus gazella
Mecopus trilineatus
Lobotrachelus troglodytes
Cylindrocopturus adspersus
Eumycterus albosquamulatus
Microcholus puncticollis
Hypurus bertrandi
Metialma straminea
Phytobius oriseomicans
Auleutes argentinensis
Ceutorhynchinae (Ceutorhynchus obstrictus)
Mononychus vulpeculus
Coeliodes flavicaudis
Conoderinae (Cylindrocopturus operculatus)
Pararobitis gibbus
Coelonertus nigrirostris
Eisonyx crassipes
Torcus nigrinus
Torcus variabilis
Plocamus echidna
Baridinae
Torcobius sp.
Xystus ater
Hiotus inflatus
Crotanius trivittatus
Paratoteles tenuirostris
Orissus meigenii
Cyriomyx camelus
Pistus galeatus
Coluthus cribrarius
Pseudobaris angusta
Craptus tibialis
Solenostemus dividuus
Onychobaris densa
Athesapeuta vinculata
Zena virgata
Madarus bistrigellus
Solaria curtula
Anopsilus oblongus
Thanius sp.
Odontocorynus scutellumalbum
Limnobaris bicincta
Coleomerus boliviensis
Leptoschoinus fucatus
Cylindridia prolixa
Derelominae (Derelomus basalis)
Balanogastris kolae
Telephae oculata
Pardisomus biplagiatus
Lydamis cinnamomeus
Camelodes leachii
Telemus sp.
Pycnotheantis sp.
Centrinopus alternatus
Cosmobaris americana
Desmoglyptus arizonicus
Moreobaris deplanata
Rhoptobaris canescens
Nanobaris sp.
Myctides imberbis
Baris torquata
Ulobaris loricata
Barycerus collaris
Madarellus laticollis
Eurhinus festivus
Eurhinus aeneus
Centrinogyna hispidula
Centrinogyna strigata
Pycnogeraeus striatirostris
Embates chaetopus
Pseudogeraeus macropterus
Nicentrus decipiens
Sibariops concinna
Geraeus lineellus
Linogeraeus urbanus
Antesis sparsa
Megabaris quadriguttata
Barilepsis griseus
Zygobaris sp.
Lichnus longulus
Barinus cribricollis
Barilepton quadrieolle
Barilepton filiforme
Barinus bivittatus
Stethobaris commixta
"Neomadarini"
Catapastus signatipennis
Catapastus seriatus
Zygobarella xanthoxyli
Catapastus squamirostris
Diorymeropsis disjuncta
Diorymeropsis xanthoxyli
Amercedes subulirostris
Amercedes orthorrhinus
Tonesia sp.
Demoda vittata
Pseudotorcus rufipes
Dirabius calvus
Pachygeraeus laevirostris
Peridinetus cretaceous
Pteracanthus smidtii
Optatus palmaris
Peridinetus irroratus
Centrinus curvirostris
Pachybaris porosa
Buchananius striatus
Oligolochus bracatus
Zygobaris nitens
Iops bicolor
Testalthea sp.
Vallopsis squamipes
Barymerus binaries
Thallabaris inermis
Centrinopsis sp.
Conoproctus quadripustulatus
Eutoxus sp.
Diorymerus lancifer
Tenemotes abdominalis
Opseobaris alba
Nertinus suturalis
Strongylotes squamans
Madopterus talpa
Parallelosomus amplitarsis
Ovanius picipennis
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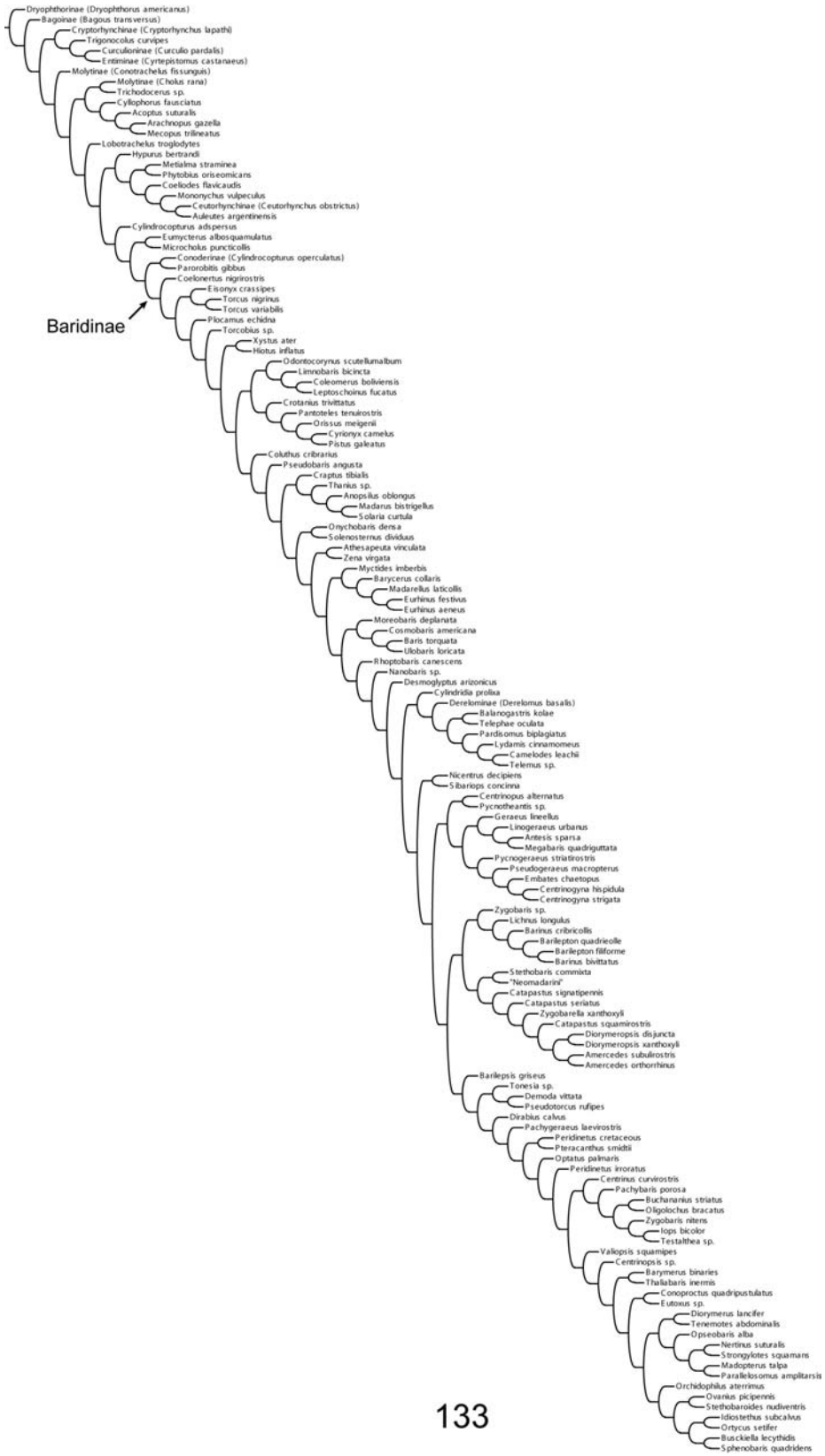
Idiostethus subcalvus
Ortycus setifer
Busckiella lecythidis
Sphenobaris quadridens

132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Bagoinae (Bagous transversus)
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Trigonocolus curvipes
Curculioninae (Curculio pardalis)
Entiminae (Cyrtepistomus castaneus)
Molytinae (Conotrachelus fissunguis)
Molytinae (Cholus rana)
Trichodocerus sp.
Cyllophorus fausciatus
Acoptus suturalis
Arachnopus gazella
Mecopus trilineatus
Lobotrachelus troglodytes
Hypurus bertrandi
Metialma straminea
Phytobius oriseomicans
Coelodes flavicaudis
Mononychus vulpeculus
Ceutorhynchinae (Ceutorhynchus obstrictus)
Auleutes argentinensis
Cylindrocopturus adspersus
Eumycterus albosquamulatus
Microcholus puncticollis
Conoderinae (Cylindrocopturus operculatus)
Parorobitis gibbus
Coelonertus nigrirostris
Eisonyx crassipes
Torcus nigrinus
Torcus variabilis
Plocamus echidna
Baridinae
Torcobius sp.
Xystus ater
Hiotus inflatus
Odontocorynus scutellumalbum
Limnobaris bicincta
Coleomerus boliviensis
Leptoschoinus fucatus
Crotanius trivittatus
Pantoteles tenuirostris
Orissus meigenii
Cyrionyx camelus
Pistus galeatus
Coluthus cribrarius
Pseudobaris angusta
Craptus tibialis
Thanius sp.
Anopsilus oblongus
Madarus bistrigellus
Solaria curtula
Onychobaris densa
Solenosternus dividuus
Athesapeuta vinculata
Zena virgata
Myctides imberbis
Barycerus collaris
Madarellus laticollis
Eurhinus festivus
Eurhinus aeneus
Moreobaris deplanata
Cosmobaris americana
Baris torquata
Ulobaris loricata
Rhoptobaris canescens
Nanobaris sp.
Desmoglyptus arizonicus
Cylindridia prolixa
Derelominae (Derelomus basalis)
Balanogastris kolae
Telephae oculata
Pardisomus biplagiatus
Lydamis cinnamomeus
Camelodes leachii
Telemus sp.
Nicentrus decipiens
Sibariops concinna
Centrinopus alternatus
Pycnotheantis sp.
Geraeus lineellus
Linogeraeus urbanus
Antesis sparsa
Megabaris quadriguttata
Pycnogeraeus striatirostris
Pseudogeraeus macropterus
Embates chaetopus
Centrinogyna hispidula
Centrinogyna strigata
Zygobaris sp.
Lichnus longulus
Barinus cribricollis
Barilepton quadrieolle
Barilepton filiforme
Barinus bivittatus
Stethobaris commixta
"Neomadarini"
Catapastus signatipennis
Catapastus seriatus
Zygobarella xanthoxyli
Catapastus squamirostris
Diorymeropsis disjuncta
Diorymeropsis xanthoxyli
Amercedes subullrostris
Amercedes orthorhinus
Barilepsis griseus
Tonesia sp.
Demoda vittata
Pseudotorcus rufipes
Dirabius calvus
Pachygeraeus laevirostris
Peridinetus cretaceous
Pteracanthus smidtii
Optatus palmaris
Peridinetus irroratus
Centrinus curvirostris
Pachybaris porosa
Buchananius striatus
Oligolochus bracatus
Zygobaris nitens
Iops bicolor
Testalthea sp.
Valiopsis squamipes
Centrinopsis sp.
Barymerus binaries
Thallabaris inermis
Conoproctus quadripustulatus
Eutoxus sp.
Diorymerus lancifer
Tenemotes abdominalis
Opseobaris alba
Nertinus suturalis
Strongylotes squamans
Madopterus talpa
Parallelosomus ampilitarsis
Orchidophilus aterrimus
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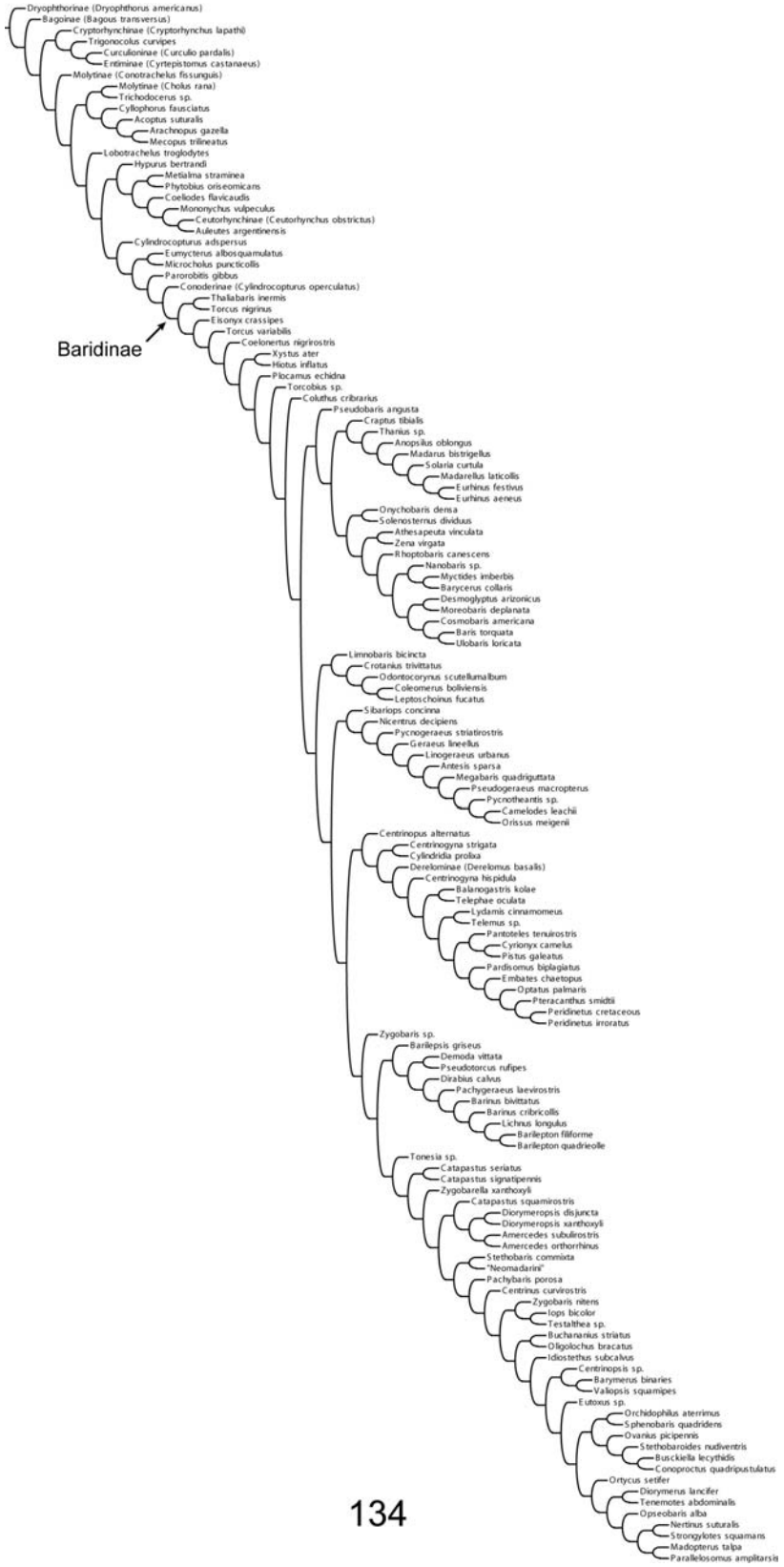
Ortycus setifer
Busckiella lecythidis
Sphenobaris quadridens

133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Bagoinae (Bagous transversus)
Cryptorhynchinae (Cryptorhynchus lapathi)
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Curculioninae (Curculio pardalis)
Entiminae (Cyrtepistomus castanaeus)
Molytinae (Conotrachelus fissunguis)
Molytinae (Cholus rana)
Trichodocerus sp.
Cyllophorus fausciatus
Acoptus suturalis
Arachnopus gazella
Mecopus trilineatus
Lobotrachelus troglodytes
Hypurus bertrandi
Metialma straminea
Phytobius oriseomicans
Coeliodes flavicaudis
Mononychus vulpeculus
Ceutorhynchinae (Ceutorhynchus obstrictus)
Auleutes argentinensis
Cylindrocopturus adspersus
Eumycterus albosquamulatus
Microcholus punctcollis
Parorobitis gibbus
Conoderinae (Cylindrocopturus operculatus)
Thaliabaris inermis
Torcus nigrinus
Elsonyx crassipes
Torcus variabilis
Baridinae
Coelonertus nigrirostris
Xystus ater
Hiotus inflatus
Plocamus echidna
Torcobius sp.
Coluthus cribrarius
Pseudobaris angusta
Craptus tibialis
Thanius sp.
Anopsilus oblongus
Madarus bistrigellus
Solaria curtula
Madarellus laticollis
Eurhinus festivus
Eurhinus aeneus
Onychobaris densa
Solenosternus dividuus
Athesapeuta vinculata
Zena virgata
Rhoptobaris canescens
Nanobaris sp.
Myctides imberbis
Barycenus collaris
Desmoglyptus arizonicus
Moreobaris deplanata
Cosmobaris americana
Baris torquata
Ulobaris loricata
Limnobaris bicincta
Crotanius trivittatus
Odontocorynus scutellumalbum
Coleomerus boliviensis
Leptoschoinus fucatus
Sibariops concinna
Nicentrus decipiens
Pycnogeraeus striatirostris
Geraeus lineellus
Linogeraeus urbanus
Antesis sparsa
Megabaris quadriguttata
Pseudogeraeus macropterus
Pycnotheantis sp.
Camelodes leachii
Orissus meigenii
Centrinopus alternatus
Centrinogyna strigata
Cylindridia prolixa
Derelominae (Derelomus basalis)
Centrinogyna hispidula
Balanogastris kolae
Telephae oculata
Lydamis cinnamomeus
Telemus sp.
Pantoteles tenuirostris
Cyrionyx camelus
Pistus galeatus
Pardisomus biplagiatus
Embates chaetopus
Optatus palmaris
Pteracanthus smidtii
Peridinetus cretaceous
Peridinetus irroratus
Zygobaris sp.
Barilepsis griseus
Demoda vittata
Pseudotorcus rufipes
Dirabius calvus
Pachygeraeus laevirostris
Barinus bivittatus
Barinus cribricollis
Lichnus longulus
Barilepton filiforme
Barilepton quadrieolle
Tonesia sp.
Catapastus seriatus
Catapastus signatipennis
Zygobarella xanthoxyli
Catapastus squamirostris
Diorymeropsis disjuncta
Diorymeropsis xanthoxyli
Amercedes subulirostris
Amercedes orthorrhinus
Stethobaris commixta
"Neomadarini"
Pachybaris porosa
Centrinus curvirostris
Zygobaris nitens
Iops bicolor
Testatithea sp.
Buchananius striatus
Oligolochus bracatus
Idiostethus subcalvus
Centrinopsis sp.
Barymerus binaries
Vallopsis squamipes
Eutoxus sp.
Orchidophilus aterrimus
Sphenobaris quadridens
Ovarius picipennis
Stethobaroides nudiventris
Busckiella lecythidis
Conoproctus quadripustulatus
Ortycus setifer
Diorymerus lancifer
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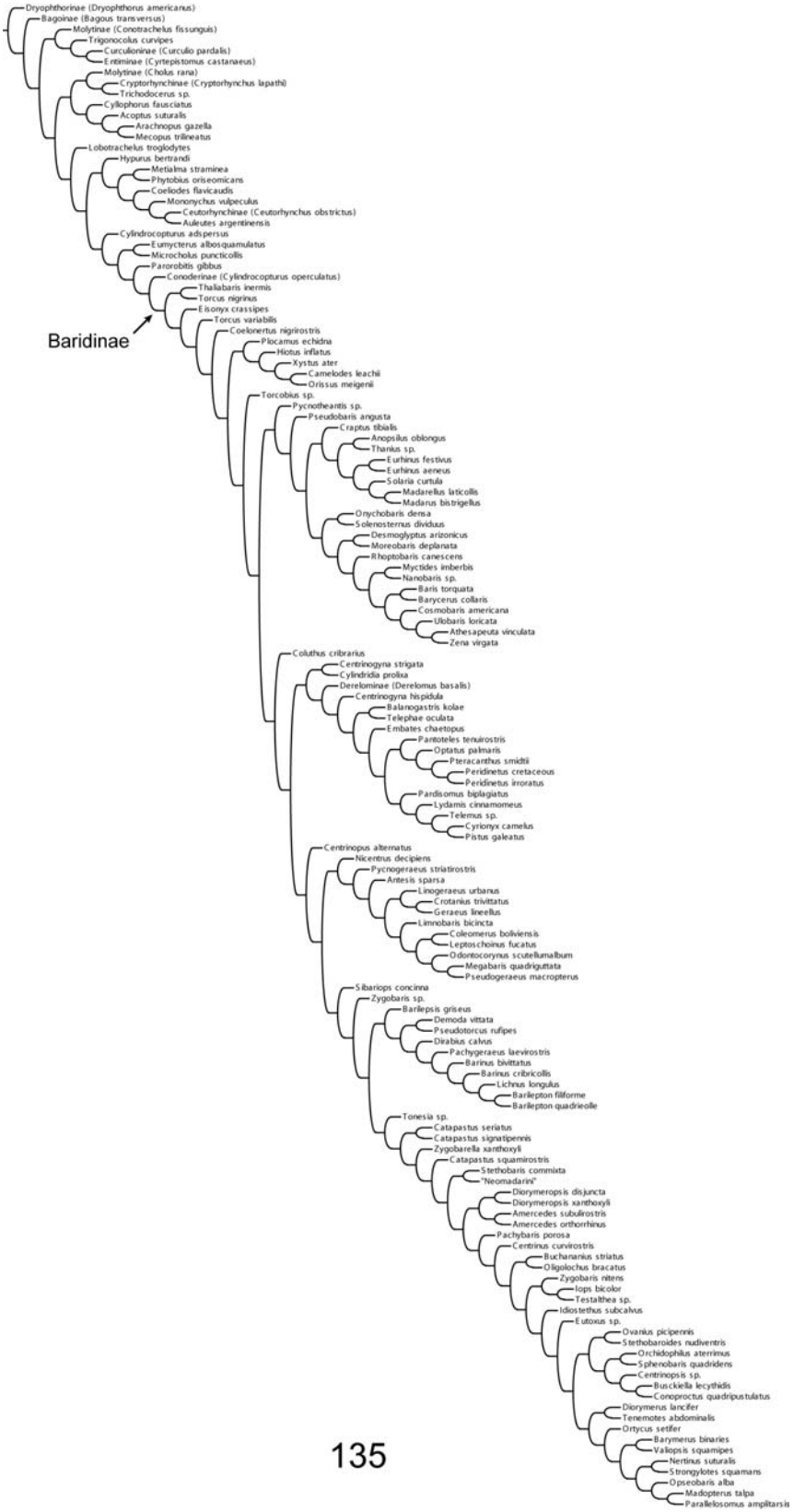
Madopterus talpa
Parallelosomus amplitarsis

134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Bagoinae (Bagous transversus)
Molytinae (Conotrachelus fissunguis)
Trigonocolus curvipes
Curculioninae (Curculio pardalis)
Entiminae (Cyrtepistomus castaneus)
Molytinae (Cholus rana)
Cryptorhynchinae (Cryptorhynchus lapathi)
Trichodocerus sp.
Cyllophorus fausciatus
Acoptus suturalis
Arachnopus gazella
Mecopus trilineatus
Lobotrachelus troglodytes
Hypurus bertrandi
Metialma straminea
Phytobius oriseomicans
Coeliodes flavicaudis
Mononychus vulpeculus
Ceutorhynchinae (Ceutorhynchus obstrictus)
Auletes argentinensis
Cylindrocopturus adspersus
Eumycterus albosquamulatus
Microcholus puncticollis
Parorobitis gibbus
Conoderinae (Cylindrocopturus operculatus)
Thaliabaris inermis
Torcus nigrinus
Eisonyx crassipes
Torcus variabilis
Baridinae
Coelonertus nigrirostris
Plocamus echidna
Hiotus inflatus
Xystus ater
Camelodes leachii
Orissus meigenii
Torcobius sp.
Pycnotheantis sp.
Pseudobaris angusta
Craptus tibialis
Anopsilus oblongus
Thanlus sp.
Eurhinus festivus
Eurhinus aeneus
Solaria curtula
Madarellus laticollis
Madarus bistrigellus
Onychobaris densa
Solenosternus dividuus
Desmoglyptus arizonicus
Moreobaris deplanata
Rhoptobaris canescens
Mycticides imberbis
Nanobaris sp.
Baris torquata
Barycerus collaris
Cosmobaris americana
Ulobaris loricata
Athesapeuta vinculata
Zena virgata
Coluthus cribrarius
Centrinogyna strigata
Cylindridia prolixa
Dereleminae (Derelomus basalis)
Centrinogyna hispidula
Balanogastris kolae
Telephae oculata
Embates chaetopus
Pantoteles tenuirostris
Optatus palmaris
Pteracanthus smidtii
Peridinetus cretaceous
Peridinetus irroratus
Pardisomus biplagiatus
Lydamis cinnamomeus
Telemus sp.
Cyrionyx camelus
Pistus galeatus
Centrinopus alternatus
Nicentrus decipiens
Pycnogeraeus striatirostris
Antesis sparsa
Linogeraeus urbanus
Crotanius trivittatus
Geraeus lineellus
Limnobaris bicincta
Coleomerus boliviensis
Leptoschoinus fucatus
Odontocorynus scutellumalbum
Megabaris quadriguttata
Pseudogeraeus macropterus
Sibariops concinna
Zygobaris sp.
Barilepsis griseus
Dimoda vittata
Pseudotorcus rufipes
Dirabius calvus
Pachygeraeus laevirostris
Barinus bivittatus
Barinus cribricollis
Lichnus longulus
Barilepton filiforme
Barilepton quadrieolle
Tonesia sp.
Catapastus seriatus
Catapastus signatipennis
Zygobarella xanthoxyli
Catapastus squamirostris
Stethobaris commixta
"Neomadarini"
Diorymeropsis disjuncta
Diorymeropsis xanthoxyli
Amercedes subulirostris
Amercedes orthorrhinus
Pachybaris porosa
Centrinus curvirostris
Buchananius striatus
Oligolochus bracatus
Zygobaris nitens
Iops bicolor
Testalthea sp.
Idiostethus subcalvus
Eutoxus sp.
Ovanius picipennis
Stethobaroides nudiventris
Orchidophilus aterrimus
Sphenobaris quadridens
Centrinopsis sp.
Busckiella lecythidis
Conoproctus quadripustulatus
Diorymerus lancifer
Tenemotes abdominalis
Ortycus setifer
Barymerus binaries
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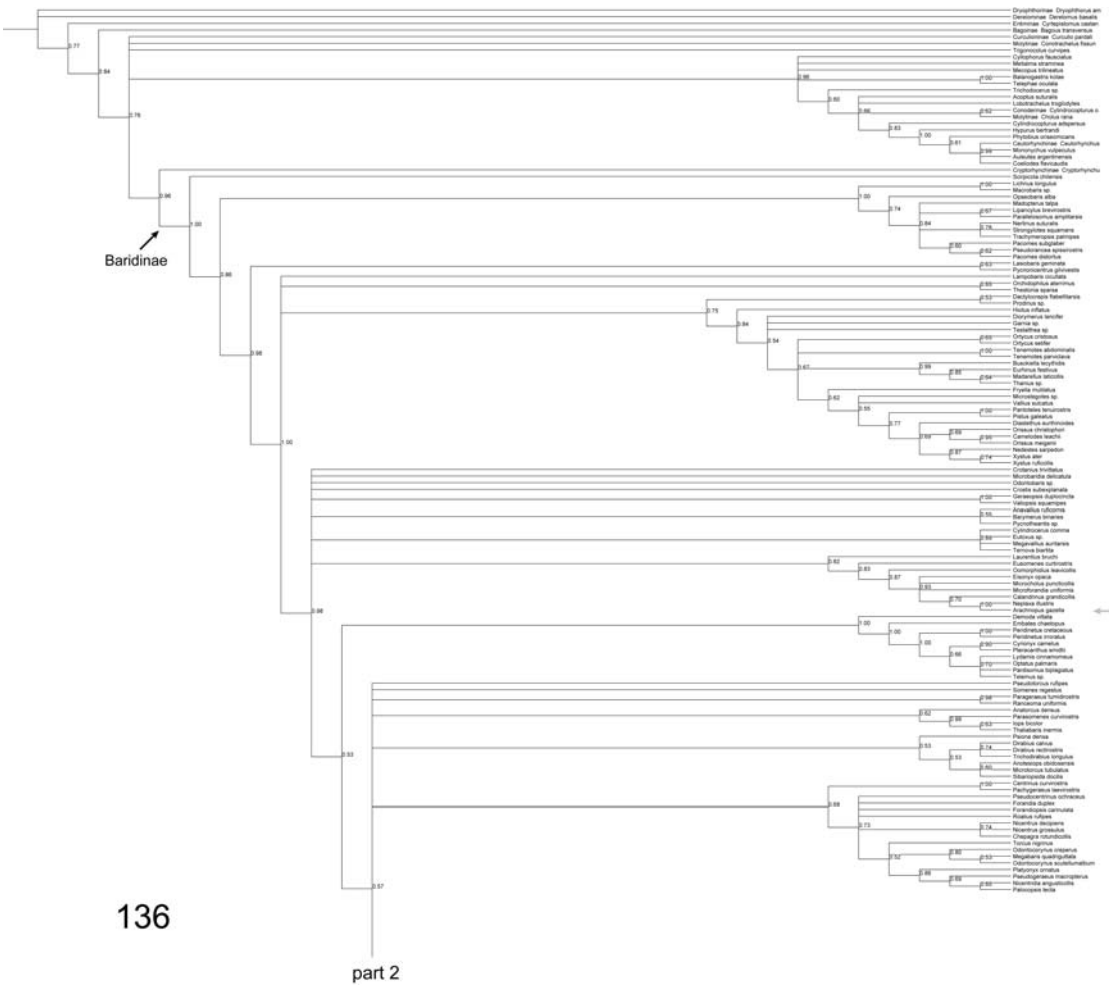
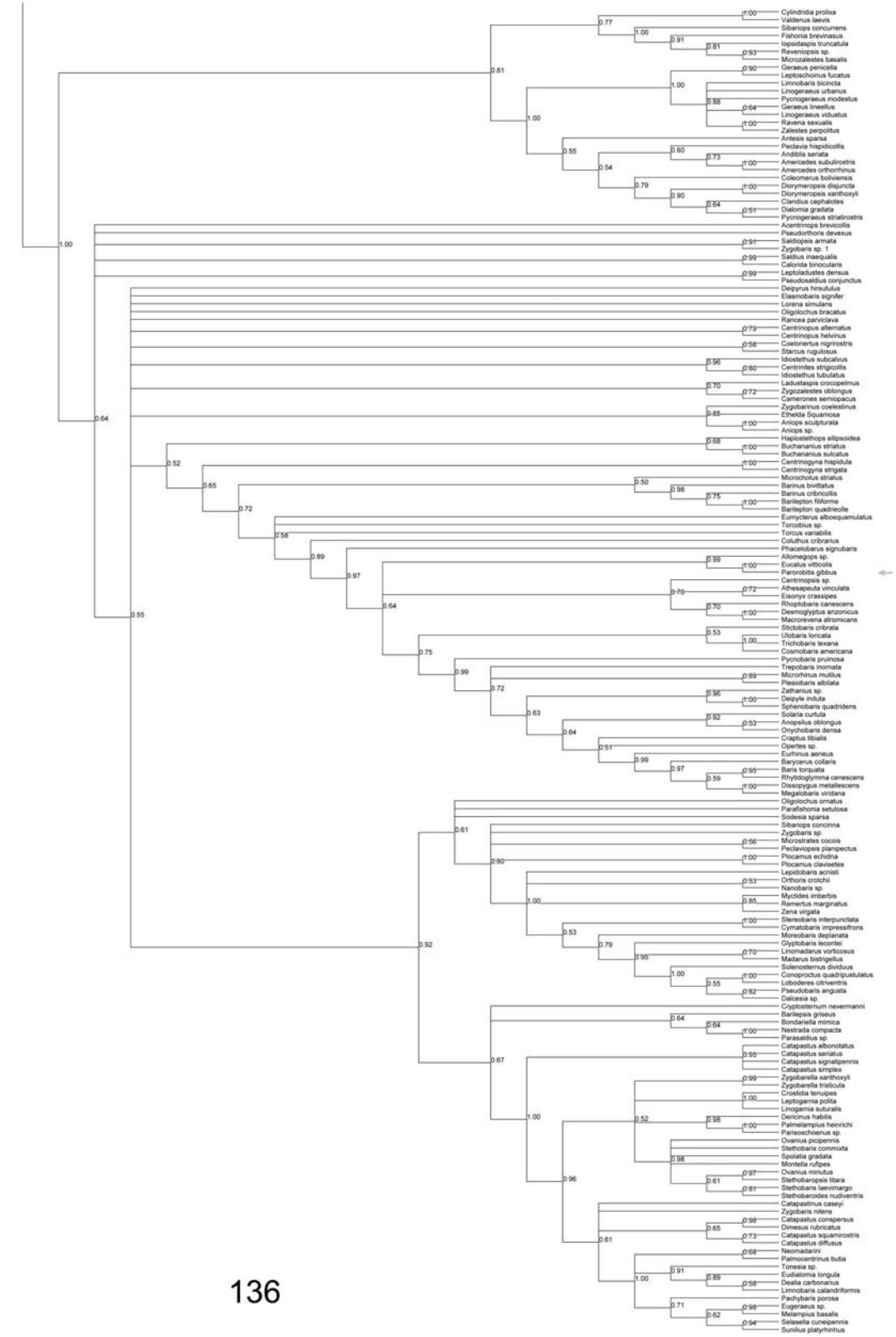
Opseobaris alba
Madopterus talpa
Parallelosomus amplitarsis

135


Baridinae
136
part 2

part 1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Leptoschoinus fucatus
Limnobaris bicincta
Linogeraeus urbanus
Pycnogeraeus modestus
Geraeus lineellus
Linogeraeus viduatus
Ravena sexualis
Zalestes perpolitus
Antesis sparsa
Peclavia hispidicollis
Andibis seriata
Amercedes subulirostris
Amercedes orthorhinus
Coleomerus boliviensis
Diorymeropsis disjuncta
Diorymeropsis xanthoxyli
Clandius cephalotes
Dialomia gradata
Pycnogeraeus striatirostris
Acentrinops brevicollis
Pseudorthoris devexus
Saldiopsis armata
Zygobaris sp. 1
Saldius inaequalis
Calorida binocularis
Leptoladustes densus
Pseudosaldius conjunctus
Deipyrus hirsutulus
Elasmobaris signifer
Lorena simulans
Oligolochus bracatus
Rancea parviclava
Centrinopus alternatus
Centrinopus helvinus
Coelonertus nigrirostris
Starcus rugulosus
Idiosethus subcalvus
Centrinites strigicollis
Idiosethus tubulatus
Ladustaspis crocopelmus
Zygozalestes oblongus
Camerones semiopacus
Zygobarinus coelestinus
Ethelda Squamosa
Aniops sculpturata
Aniops sp.
Haplosethops ellipsoidea
Buchananius striatus
Buchananius sulcatus
Centrinogyna hispidula
Centrinogyna strigata
Microcholus striatus
Barinus bivittatus
Barinus cribricollis
Barilepton filiforme
Barilepton quadrieolle
Eumycterus albosquamulatus
Torcobius sp.
Torcus variabilis
Colluthus cribrarius
Phacelobarus signubaris
Allomegops sp.
Eucalus viticollis
Pararobitis gibbus
Centrinopsis sp.
Athesapeuta vinculata
Eisonyx crassipes
Rhoptobaris canescens
Desmoglyptus arizonicus
Macrorevena atromicans
Stictobaris cribrata
Utobaris loricata
Trichobaris texana
Cosmobaris americana
Pycnobaris pruinosa
Trepobaris inornata
Microrhinus mutilus
Plesiobaris albilata
Zathanius sp.
Deipyle induta
Sphenobaris quadridens
Solaria curtula
Anopsilus oblongus
Onychobaris densa
Craptus tibialis
Opertes sp.
Eurhinus aeneus
Barycerus collaris
Baris torquata
Rhytidoglymma cenescens
Dissopygus metallescens
Megalobaris viridana
Oligolochus ornatus
Parafishonia setulosa
Sodesia sparsa
Sibariops concinna
Zygobaris sp.
Microstrates cocois
Peclaviopsis planipectus
Plocamus echidna
Plocamus claviseles
Lepidobaris acnisti
Orthoris crotchii
Nanobaris sp.
Myctides imberbis
Rementus marginatus
Zena virgata
Stereobaris interpunctata
Cymatobaris impressifrons
Moreobaris deplanata
Glyptobaris lecontei
Linomadarus vorticosus
Madarus bistrigellus
Solenosternus dividuus
Conoproctus quadripustulatus
Loboderes citriventris
Pseudobaris angusta
Dalcesia sp.
Cryptosternum nevermanni
Barilepsis griseus
Bondariella mimica
Nestrada compacta
Parasaldius sp.
Catapastus albonotatus
Catapastus seriatus
Catapastus signatipennis
Catapastus simplex
Zygobarella xanthoxyli
Zygobarella tristicula
Crostidia tenuipes
Leptogamia polita
Linogamia suturalis
Dericinus habilis
Palmelampius heinrichi
Parisoschoenus sp.
Ovanius picipennis
Stethobaris commixta
Spoliatia gradata
Montella rufipes
Ovanius minutus
Stethobaropsis titara
Stethobaris laevimargo
Stethobaroides nudiventris
Catapastinus caseyi
Zygobaris nitens
Catapastus conspersus
Dimesus rubricatus
Catapastus squamicostris
Catapastus diffusus
Neomadarini
Palmocentrinus butia
Tonesia sp.
Eudialomia longula
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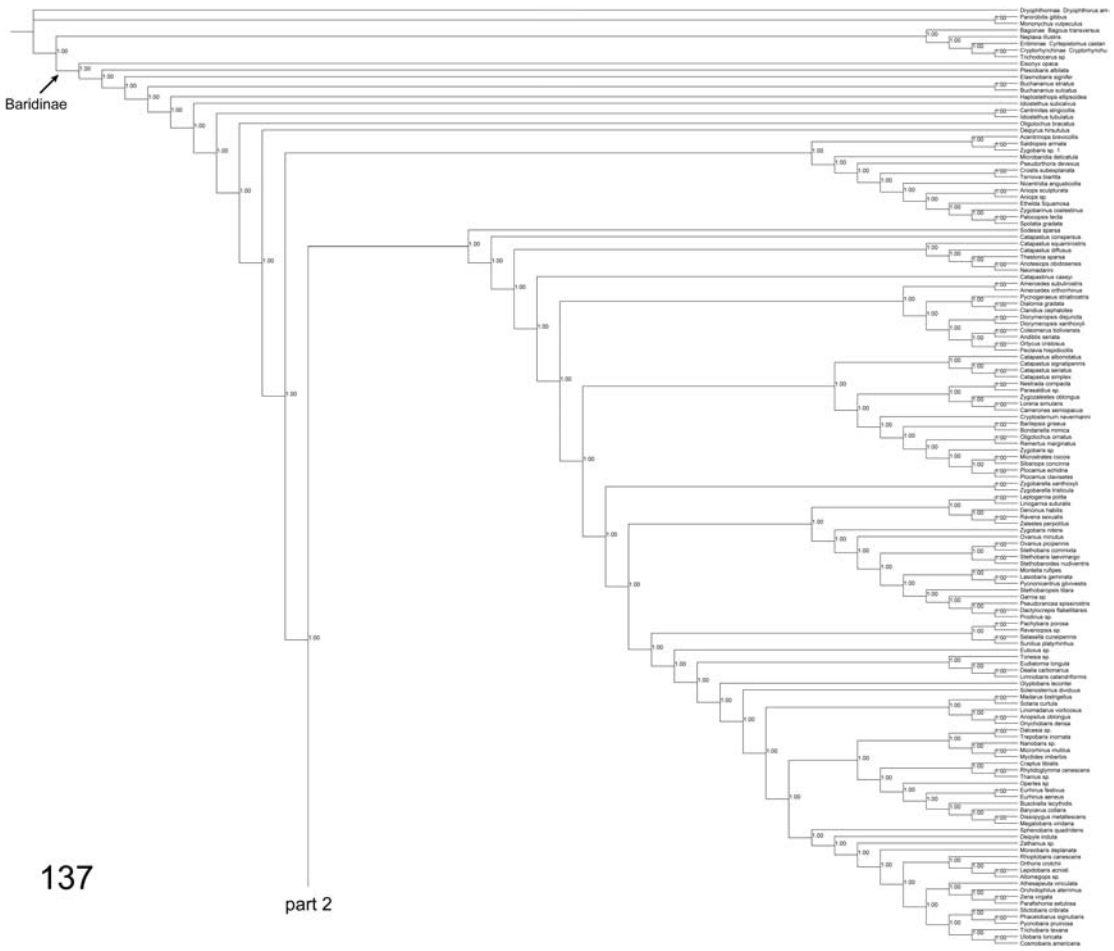
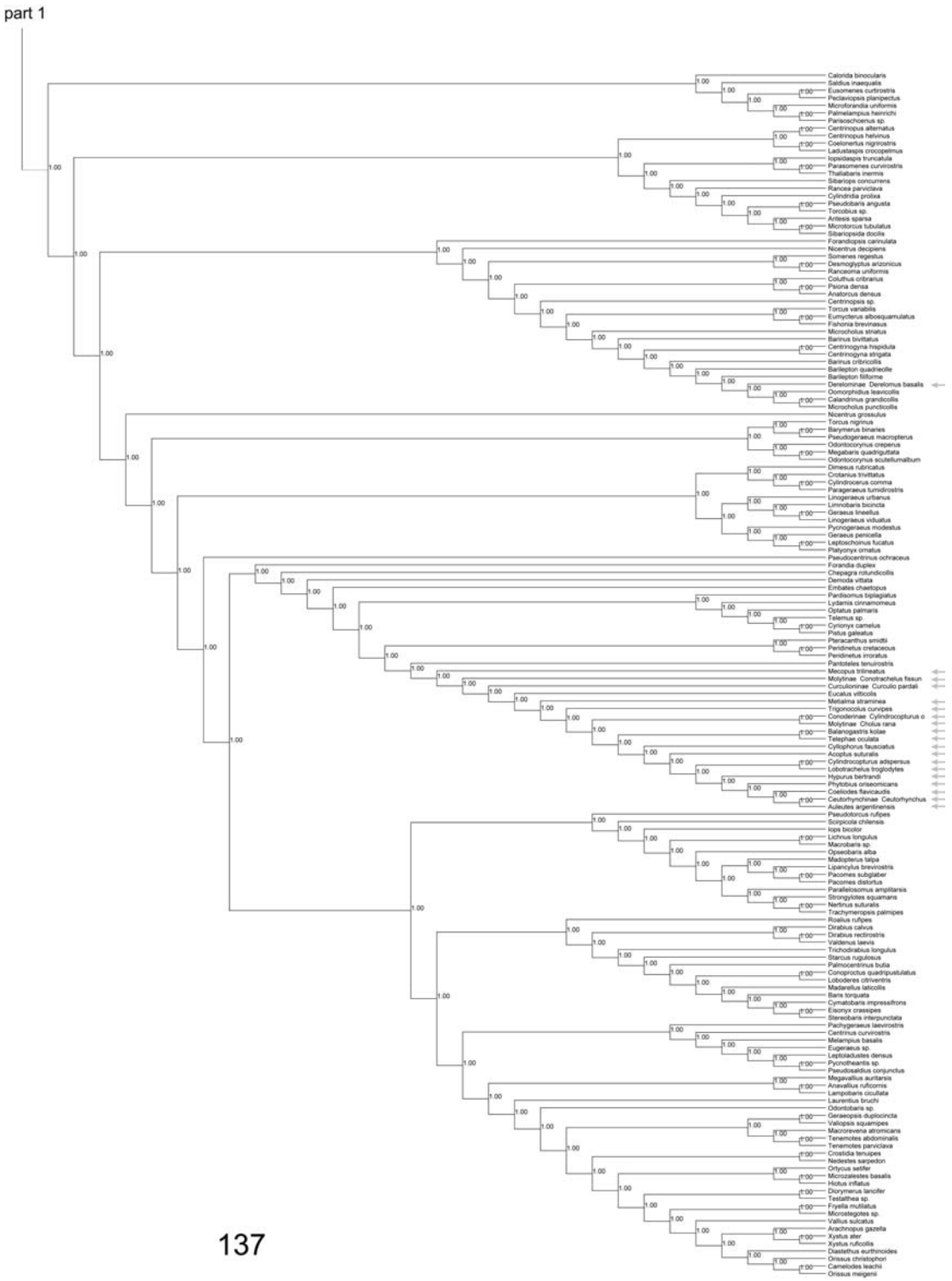
Sunilius platyrhinhus

136


Baridinae
137
part 2


part 1
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Microforandia uniformis
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Parisocholenus sp.
Centrinopus alternatus
Centrinopus helvinus
Coelonerius nigrirostris
Ladustaspis crocopelmus
Iopsidaspis truncatula
Parasomenes curvirostris
Thaliabaris inermis
Sibaricops concurrens
Rancea parviclava
Cylindridia prolixa
Pseudobaris angusta
Torcobius sp.
Antesis sparsa
Microtorcus tubulatus
Sibariopsida docilis
Forandiopsis carinulata
Nicentrus decipiens
Somenes regestus
Desmogyptus arizonicus
Ranceoma uniformis
Coluthus cribrarius
Psiona denisa
Anatorcus densus
Centrinopsis sp.
Torcus variabilis
Eumycterus albosquamulatus
Fishonia brevinasus
Microcholus striatus
Barinus bivittatus
Centrinogyna hispidula
Centrinogyna strigata
Barinus cribricollis
Barileptor quadrieollo
Barileptor filiforme
Dereleminae Dereleomus basalis
Oomorphidius leavicollis
Calandrinus grandicollis
Microcholus punctiicollis
Nicentrus grossulus
Torcus nigrinus
Barynerus binaries
Pseudogeraeus macropterus
Odontocorynus creperus
Megabaris quadrigutlata
Odontocorynus scutellumalbum
Dimesus rubricatus
Crotanius trivittatus
Cylindrocerus comma
Paragereaus tumidirostris
Linogeraeus urbanus
Limnobaris bicincta
Geraeus lineellus
Linogeraeus viduatus
Pycnogeraeus modestus
Geraeus penicella
Leptoschoinus fucatus
Platyonyx ornatus
Pseudocentrinus ochraceus
Forandia duplex
Chepagra rotundicollis
Demoda vittata
Embates chaetopus
Pardisomus bipiagiatus
Lydamis cinnamomeus
Optatus palmaris
Telemus sp.
Cyrionyx camelus
Pistus galeatus
Pteracanthus smidti
Peridinetus cretaceous
Peridinetus incratus
Pantoteles tenuirostris
Mecopus trilineatus
Molytinae Conotrachelus fissun
Curculioninae Curculio pardali
Eucalus vitticolis
Metialma straminea
Trigonocolus curvipes
Conoderinae Cylindrocopturus o
Molytinae Cholus rana
Balanogastris kolae
Telephae oculata
Cyllophorus fasciatus
Acoptus suturalis
Cylindrocopturus adspersus
Lobotrachelus troglodytes
Hypurus bertrandi
Phytobius oriseomicans
Coelodes flavicaudis
Ceutorhynchinae Ceutorhynchus
Auleutes argentinensis
Pseudotorcus rufipes
Scripcola chilensis
Iops bicolor
Lichnus longulus
Macrobaris sp.
Opseobaris alba
Madopterus talpa
Lipancylus brevirostris
Pacomes subglaber
Pacomes distortus
Parallelosomus amplitarsis
Strongylotes squamans
Nertinus suturalis
Trachymeropsis palmipes
Roalius rufipes
Dirabius calvus
Dirabius rectirostris
Valdenus laevis
Trichodirabius longulus
Starcus rugulosus
Palmocentrinus butia
Conoproctus quadripustulatus
Loboderes obtriventris
Madarellus laticollis
Baris torquata
Cymatobaris impressifrons
Eisonyx crassipes
Stereobaris interpunctata
Pachygeraeus laevirostris
Centrinus curvirostris
Melampius basalis
Eugeraeus sp.
Leptoladustes densus
Pycnotheantis sp.
Pseudosaldius conjunctus
Megavallius auritarsis
Anavallius ruficornis
Lampobaris cicultata
Laurentius bruchi
Odontobaris sp.
Geraeopsis duplocincta
Vallopsis squamipes
Macrorevena atromicans
Tenemotes abdominalis
Tenemotes parviclava
Crostidia tenuipes
Nedestes sarpedon
Ortycus setifer
Microzalestes basalis
Hotus inflatus
Diorymerus lancifer
Testalthea sp.
Fryella mutilatus
Microstegotes sp.
Vallus sulcatus
Arachnopus gazella
Xystus ater
Xystus ruficollis
Diastethus eurthinoides
Orissus christophori
Cameloides leachi
Orissus meigenii

137


Dryophthorinae Dryophthorus americanus
Bagoinae Bagous transversus
Entiminae Cyrtepistomus castanaeus
Curculioninae Curculio pardalis
Molytinae Conotrachelus fissunguis
Cryptorhynchinae Cryptorhynchus lapathi
Metialma straminea
Trigonocolus curvipes
Cyllophorus fausciatus
Mecopus trilineatus
Balanogastris kolae
Telephae oculata
Acoptus suturalis
Trichodocerus sp
Conoderinae Cylindrocopturus operculatus
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Lobotrachelus troglodytes
Cylindrocopturus adspersus
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Hypurus bertrandi
Pararobitis gibbus
Auleutes argentinensis
Mononychus vulpeculus
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Microcholus punctiicollis
Eisonyx crassipes
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Tonesia sp
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Zena virgata
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Solenosternus dividuus
Anopsilus oblongus
Thanius sp
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Craptus tibialis
Onychobaris densa
Solaria curtula
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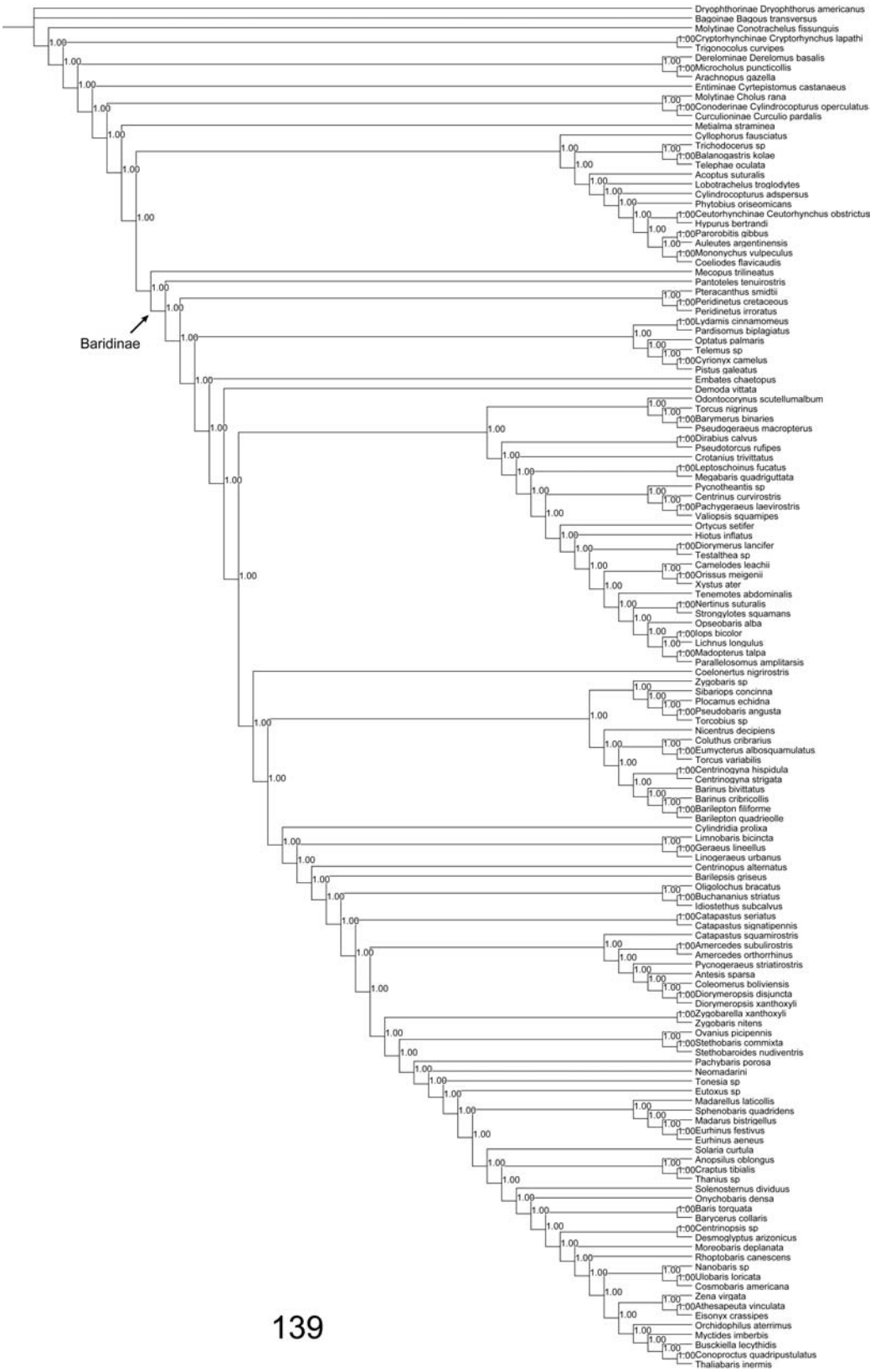
Eurhinus festivus
Eurhinus aeneus

138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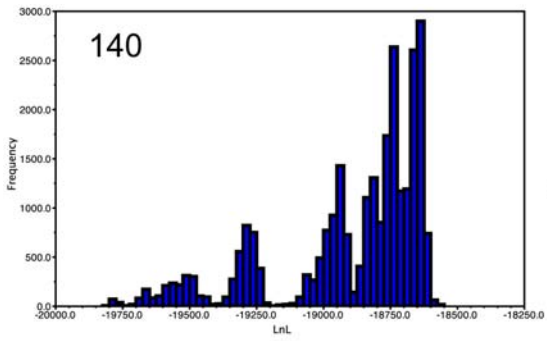
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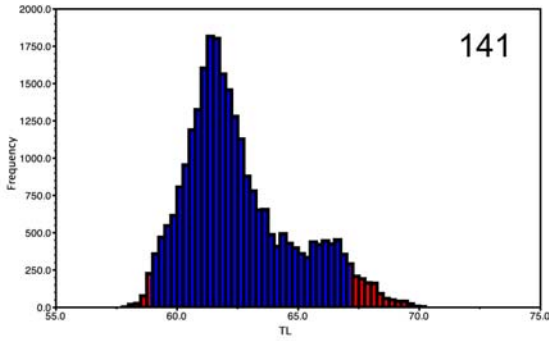
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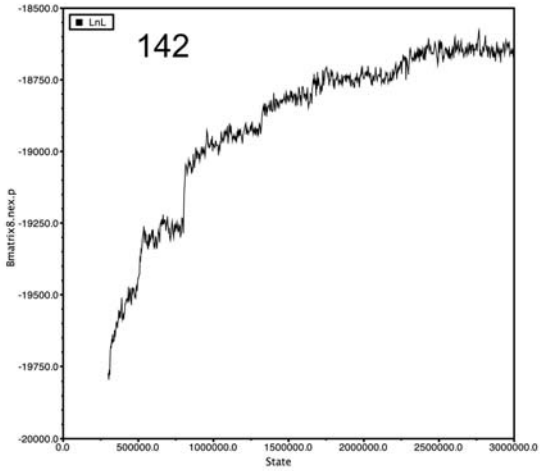
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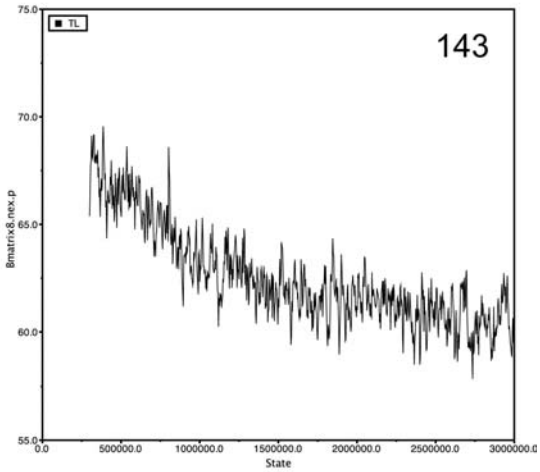
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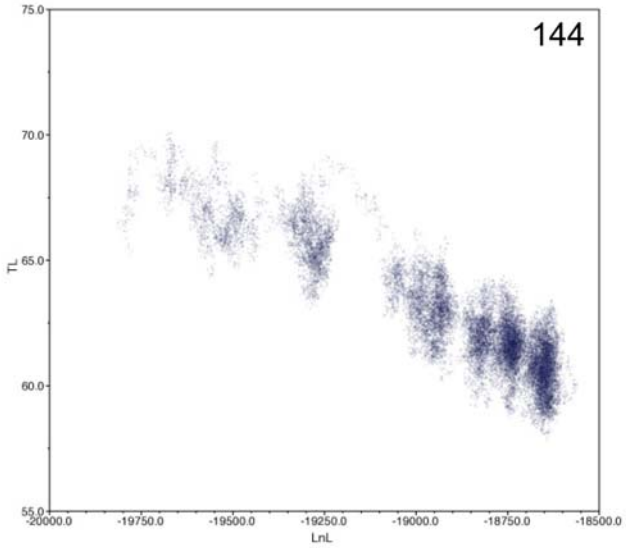
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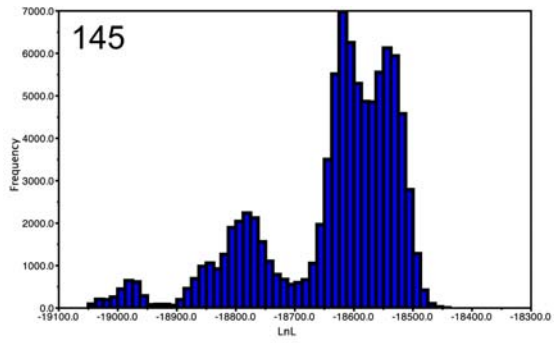
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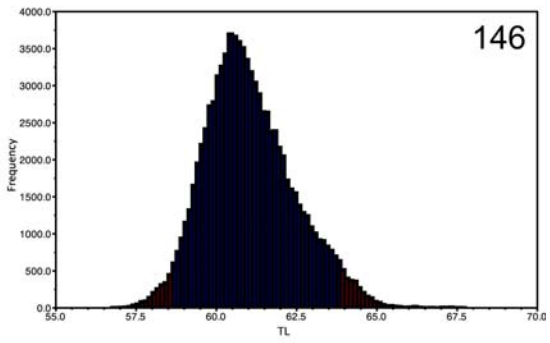
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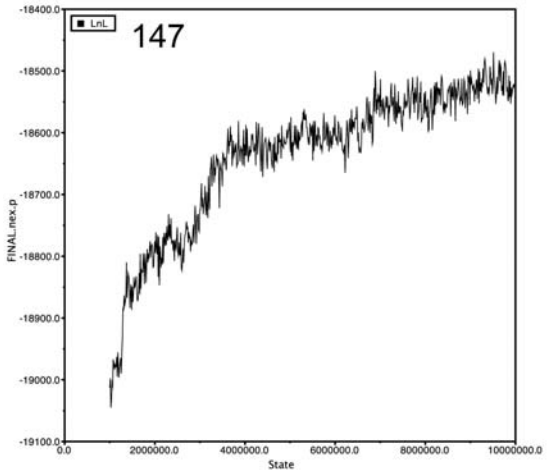
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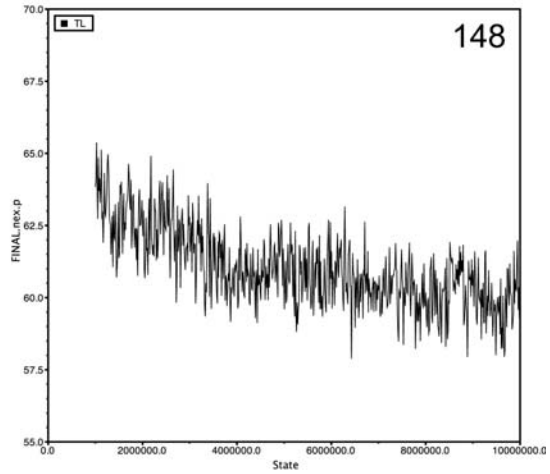
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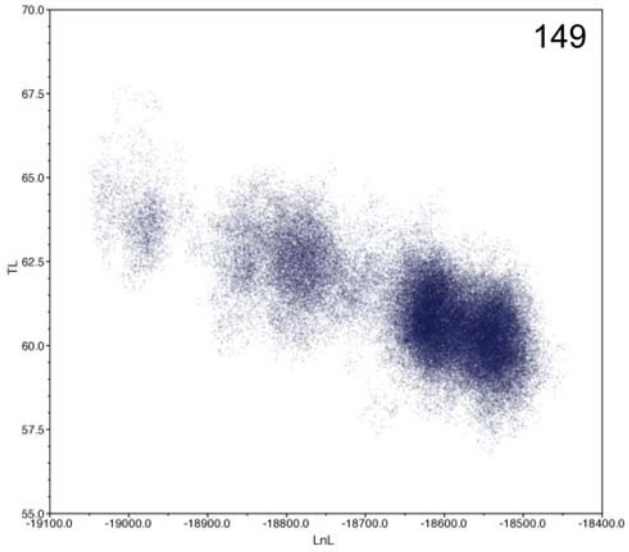
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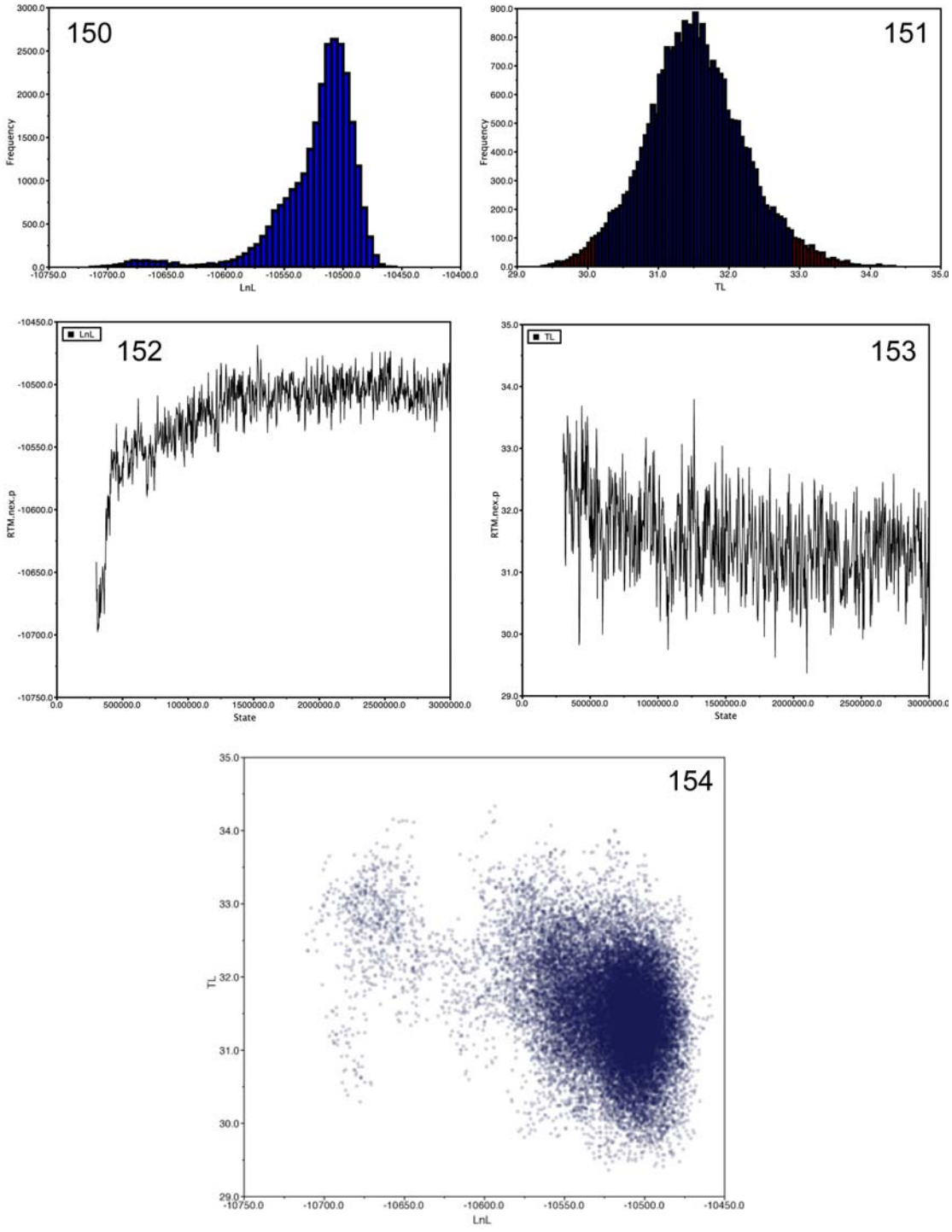
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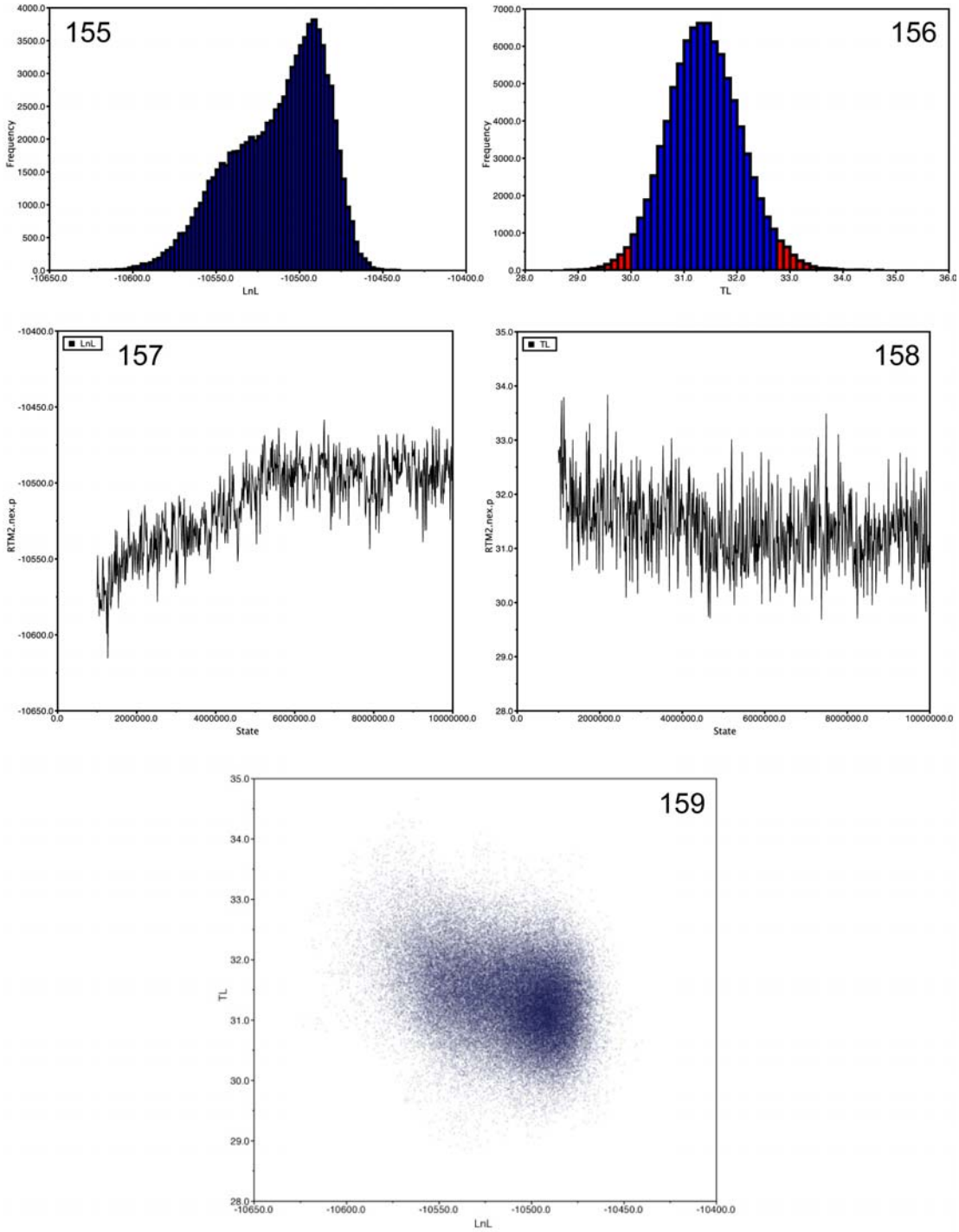
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Chapter III: Evolution of pro-sternal horns in baridine weevils (Coleoptera: Curculionidae)

Abstract

Weevils (family Curculionidae) are one of the most diverse groups of extant organisms, with approximately 60,000 described species. They are extremely important economically, being of great agricultural significance because they are associated with all major groups of plants and plant parts. The weevil subfamily Baridinae is one of the larger weevil lineages. It is distributed worldwide, consists of 548 genera, approximately 9,000 described species, and is considered most in need of systematic study. Like the remainder of Curculionidae, there exists no phylogenetic hypothesis for the evolution of Baridinae. In order to provide stability to the group and to define the major lineages, the first phylogenetic hypothesis, based on morphological data, was constructed, providing a framework for the subfamily from which all future research on this group will be derived. The construction of a phylogenetic hypothesis then permits examination of the evolution of certain traits in the organisms, such as the defensive horns that are present in many baridine species. These horns, like those present in other beetles, are used during male-male competition, in which males spar with them in order to gain female mating rights. The fighting exhibited by these weevils, however, is unlike any other known in the insects. Moreover, it appears that horns have evolved multiple times in the

subfamily, as illustrated by their structural differences, and the evolution of other traits, such as stridulation, may be closely associated.

Keywords: Baridinae, horns, mating behavior, male intra-specific competition

Introduction

Modification of the body and appendages for use in conspecific battles during mating is common in insects. Pro-thoracic horns have evolved numerous times in insects, most notably in the beetles (Coleoptera). Of these numerous, independent evolutionary events, horns have evoloved from certain modified appendages and can be found in various locations on the beetle pro-thorax, namely on the pro-notum, as in Scarabaeidae, on the mandibles, as in Lucanidae (Stag beetles), and on the pro-sternum, as in weevils (Curculionidae). The presence of horns at these different locations, together with their morphological structure, determine specific functions. For example, horns present on the mobile head and immobile horns present on the pro-notum serve a clamping function, often used to lift an opponent and clamp it between the pair of horns. Horns evolved from modified mandibles move laterally in a scissor-like fashion and also are used to capture and immobilize an opponent between them. Those beetles with elongate, straight horns, often projecting from the pro-notum, are used to dislodge the opponent from a surface through a lifting action (Eberhard and Garcia-C. 2000).

Weevils are considered one of the largest groups of organisms on the planet, comprising approximately 60,000 described species. In weevils, the legs most often are modified for intraspecific male-male fighting. For example, in *Rhinostomus barbirostris*, the males possess elongate fore-legs that function to pry an opponent off of a female and push it off of a substrate (often vegetation). In *Macromerus bicinctus*, the male uses its swollen tibiae to strike opponents (Wcislo and Eberhard 1989). In the weevil subfamily Baridinae, including a few genera in closely-related subfamilies (Conoderinae), males have evolved horns on the pro-sternum that function in male-male combat, though other functions may be likely. These horns vary in development among males of different sizes (the smaller males possessing smaller horns) and vary in morphological structure (Figs. 1-61, 67-73). Many species possessing horns, though not all,also possess an invagination between them (Figs. 62-66), referred to as the horn sheath. Few studies have examined the evolution of beetle horns using phylogenies. Those that have (Emlen *et al*. 2005) did so with scarab beetles (Scarabaeidae), which possess dorsal horns on the pro-notum.

Materials and methods

Scanning Electron Microscopy:

All SEM images were captured using a LEO 1550 FESEM. Specimens were mounted on an SEM stub using Leit-C-Plast adhesive and an isopropanol-based colloidal graphite. Whole specimens were placed on insect pins or glued to paper points, securing the pin or point on an SEM stub using Leit-C-Plast. Dissected parts

were mounted on a stub by securing them with a thin layer of colloidal graphite. After the desired parts were mounted, coating was performed using gold.

Taxon sampling:

Following Alonso-Zarazaga and Lyal (1999), species were sampled from each of the 9 tribes and 17 subtribes in Baridinae, with a total of 283 baridine species, representing 270 genera (out of a total of 546 genera), included in the analysis. A total of 29 species were sampled for the outgroup, consisting of 12 subfamilies outside of Baridinae. The final analysis included a total of 301 taxa. Outgroup selection was based on phylogenies produced by Marvaldi *et al.* (2002), and previous baridine classifications by Zherikhin and Egorov (1990), and Zherikhin and Gratshev (1995).

Taxa were borrowed from the following institutions:

USNM – National Museum of Natural History (United States National Museum), Smithsonian Institution, Washington, D.C., USA.

SEMC – Snow Entomological Museum, University of Kansas, Lawrence, Kansas, USA.

CMNC – Canadian Museum of Nature, Ottawa, Canada.

IZCAS – Institute of Zoology, Chinese Academy of Sciences, Beijing, China.

CAS – California Academy of Sciences, San Francisco, California, USA.

FMNH – Field Museum of Natural History, Chicago, Illinois, USA.

Phylogenetic analysis:

The data matrix was compiled in WinClada. Phylogenetic analyses were performed using NONA and TNT (Tree search implementing New Technology). In NONA, two alternative styles were used for ratchet runs during tree exploration. One ran single ratchet sets for 4,000 iterations while sampling 35 to 50 characters and holding 1 tree per iteration. The second style was utilizing multi-ratchet sets. One set of runs used 2 simultaneous threads and 10 sequential ratchet runs, performing 200 iterations per run while sampling 35 to 45 characters and holding 1 tree per iteration. Another set of runs used 2 simultaneous threads and 20 sequential ratchet runs, performing 100 iterations per run while sampling 35 characters and holding 1 tree per iteration.

The trees presented are those obtained through analyses in TNT. Runs in TNT consisted of implementing sectorial searches (SS) with tree drifting (TD) and tree fusing (TF) and ratchet runs with TD and TF. The final tree was computed using TNT by implementing 500 sequential ratchet runs of 1,000 iterations, including 100 cycles of both TD and TF per iteration.

Behavior of male baridines possessing horns

Of the 47 baridine genera that have been found to possess pro-sternal horns (Table 1), the fighting behavior of one species that possesses horns, *Parisoschoenus expositus* Champion, has been thoroughly documented (Eberhard and Garcia-C.

2000). Aggressive behavior in *P. expositus* assumes usually when a male is courting or mating with a female and another male approaches the pair. The first aggressive behavior displayed by the approaching male is to use its rostrum to move or lift the courting male away from the female. The horns, however, never have been observed to perform this lifting or shoving action. When the courting male is separated from the female, the two males will then face each other and rapidly move the apex of their abdomen in an anterior-posterior fashion. This behavior is believed to produce warning sounds that are generated from the interaction of sound producing structures located at the apex of the body. A file is present on the inner apical margin of each elytron and corresponding rows of plectra are present on the last visible abdominal tergite (the 7^{th} tergite). When the plectra move across the surface of the file they produce a sound (which to the present time has not been recorded from weevils). This rapid movement of the abdominal apex only occurs during male-male fighting, and it is hypothesized that these weevils only produce sound during aggressive encounters (as opposed to during courtship). At this time the male pair may resume to strike each other with their rostra or they may then engage in horn-locking. In the latter situation, each male will tilt its body sideways and proceed to push its horns into the opponents horn sheath. If one of the males does not tilt its body, horn-locking will fail, as each male's horn sheath can only receive the opponents horn when their bodies are tilted in an appropriate orientation. Thus, the horn of one male can only enter the sheath of the opponent when the opponent's horn is oriented correctly to enter the other male's sheath. When the horns of each male have

interlocked, the orientation of either male does not greatly change, though one male may partially lift his opponent from the substrate. The purpose of this type of fighting, however, appears not to be to lift the opponent up or to flip him over. Rather, the strength of the male seems to be assessed by his ability to push the opponent. Once it is clear which of the males is greater in strength, the lesser weevil most often disperses from the site.

Types and diversity of horns

Five general types of pro-sternal horns have been included in the phylogeny associated with this study, although more have been observed in Baridinae. These types are: 1) horns long, invagination (horn sheath) reduced/shallow to absent, 2) horns long, horn sheath developed and bifurcate, 3) horns long, horn sheath developed and simple, 4) horns short/reduced, horn sheath reduced/shallow to absent, and 5) horns fused, horn sheath developed and simple. In addition to these types, one other has been observed within the genus *Groatus*, in which there are two horn sheaths, one adjacent to each horn. Within these general types, a wealth of diversity exists between genera as well as among species within genera. For instance, species of *Dactylocrepis* possess spade-like horns that are laterally flattened (Figs. 15-17). The genus *Theantis* (not included in the phylogeny), similar to *Limnobaris* (Figs. 37-39), possesses horns which are elevated on a shelf-like projection of the pro-sternum and are dorso-ventrally flattened. It is without a doubt that many more horn types will be discovered upon further examination of other baridine genera.

Evolution of pro-sternal horns in Baridinae

In contrast to previous studies involving baridines that possess relatively long horns and elongate horn sheaths, a great diversity of horns and horn sheaths have evolved multiple times throughout the subfamily (Fig. 74). As the phylogenetic results hypothesize, the 5 general types of horns have evolved multiple times. Although it is possible that all ancestral baridines possessed horns and were subsequently lost in a large majority of the extant taxa, it is much more parsimonious and likely that most ancestral baridine species did not possess pro-sternal horns, and many taxa have independently evolved them. This latter hypothesis is also supported by the inter-generic morphological differences seen in the horns. These differences also may be a result of behavioral differences. The behavior of only a few species has been studied, and in a large number of taxa it is possible that these horns play an insignificant role in male-male aggression.

Correlation between the presence of the different types of horns and the presence of plectra (sound-producing stridulatory structures) on the 7^{th} tergite of the abdomen was also examined, as it is known that the presence of both are strongly associated with the display of aggressive behavior in males. These characters were mapped onto the strict consensus tree and adjacently aligned (Fig. 74). As apparent from the aligned trees, the presence of horns strongly correlates with the presence of plectra. Also, the taxa that possess horns which are reduced in size usually also possess the sparsely-arranged form of plectra, and the taxa that possess long horns

usually also possess the densely-arranged form of plectra. This correlation may indicate that species with small (nearly absent) horns also either do not stridulate as much (due to the reduced form of the plectra and file) or produce much different sounds than do species which possess the densely-arranged form of plectra (and file). Conversely, the species with long, well-developed horns may either stridulate better or produce different sounds than the species that possess the reduced form of plectra.

Since many more baridine genera (and non-baridine) possess horns than were examined in this study, the accuracy of the phylogeny and evolutionary history of the horns presented here is uncertain. Future research that will provide insight into baridine horn evolution should include examination of the development and developmental pathways of the horns in different taxa (Emlen *et al*. 2006, 2007). These types of studies will help elucidate the feasibility of multiple gains and losses of pro-sternal horns in weevils.

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Acknowledgements

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Figure captions

Figs. 1-8. Adult photographs. 1-3, *Camelodes leachii*. 1, lateral view; 2, dorsal view; 3, ventral view of pro-sternum. 4-6, *Centrinus curvirostris*. 4, lateral view; 5, dorsal view; 6, ventral view of pro-sternum. 7-8, *Crotanius trivittatus*. 7, lateral view; 8, dorsal view.

Figs. 9-16. Adult photographs. 9, *Crotanius trivittatus*, ventral view of pro-sternum. 10-11, *Cylindridia prolixa*. 10, lateral view; 11, dorsal view. 12-14, *Cylindrocerus*

comma. 12, lateral view; 13, dorsal view; 14, ventral view of pro-sternum. 15-16, *Dactylocrepis flabellitarsis*. 15, lateral view; 16, dorsal view.

Figs. 17-24. Adult photographs. 17, *Dactylocrepis flabellitarsis*, ventral view of pro-sternum. 18-19, *Demoda vittata*. 18, lateral view; 19, dorsal view. 20-21, *Dialomia gradata*. 20, lateral view; 21, dorsal view. 22-24, *Dimesus rubricatus*. 22, lateral view; 23, dorsal view. 24, *Diorymerus lancifer*.

Figs. 25-32. Adult photographs. 25, *Diorymerus lancifer*, dorsal view. 26-28, *Eugeraeus* sp. 26, lateral view; 27, dorsal view; 28, ventral view of pro-sternum. 29-31, *Eutoxus* sp. 29, lateral view; 30, dorsal view; 31, ventral view of pro-sternum. 32, *Geraeus lineellus*, lateral view.

Figs. 33-40. Adult photographs. 33-34, *Geraeus lineellus*. 33, dorsal view; 34, ventral view of pro-sternum. 35-36, *Lampobaris cicullata*. 35, lateral view; 36, dorsal view. 37-39, *Limnobaris calandriformis*. 37, lateral view; 38, dorsal view; 39, ventral view of pro-sternum. 40, *Linogeraeus viduatus*, lateral view.

Figs. 41-48. Adult photographs. 41, *Linogeraeus viduatus*, dorsal view. 42-43, *Nestrada compacta*. 42, lateral view; 43, dorsal view. 44-46, *Orissus christophori*. 44, lateral view; 45, dorsal view; 46, ventral view of pro-sternum. 47-48, *Orissus meigenii*. 47, lateral view; 48, dorsal view.

Figs. 49-56. Adult photographs. 49, *Orissus meigenii*, ventral view of pro-sternum. 50-51, *Pachygeraeus laevirostris*. 50, lateral view; 51, ventral view of pro-sternum. 52-54, *Pachygeraeus tumidirostris*. 52, lateral view; 53, dorsal view; 54, ventral view of pro-sternum. 55-56, *Parasaldius* sp. 55, lateral view; 56, dorsal view.

Figs. 57-66. Adult photographs. 57-58, *Torcus variabilis*. 57, lateral view; 58, dorsal view. 59-61, *Xystus ater*. 59, lateral view; 60, dorsal view; 61, ventral view of pro-sternum. 62-66, pro-notum, posterior view, showing horn sheaths. 62-63, *Orissus meigenii*. 62, posterior view; 63, lateral view. 64, *Orissus christophori*; 65, *Demoda vittata*; 66, *Pseudotorcus rufipes*.

Figs. 67-73. SEM's. 67-68, *Centrinopus alternatus*. 67, adult, lateral view; 68, enlargement of horns. 69-70, *Cylindridia prolixa*. 69, adult, lateral view; 70, enlargement of horns. 71-72, *Geraeus lineellus*. 71, lateral view; 72, enlargement of horn base. 73, *Demoda vittata*.

Fig. 74. Strict consensus tree of Baridinae (see Chapter II for details), with horn evolution mapped onto the left phylogeny and plectra evolution mapped onto the right phylogeny.

Table 1. List of genera known to possess pro-sternal horns. Species listed include those examined (but this is not an exhaustive list of examined taxa).

Mecopus trilineatus
Crotanius trivittatus
Cylindrocerus comma
Dimesus rubricatus
Linogeraeus viduatus
Geraeus lineellus
Parageraeus tumidirostris
Pseudorancea spissirostris
Melampius basalis
Eugeraeus spp.
Pachygeraeus laevirostris
Centrinus curvirostris
Anavallius ruficornis
Lampobaris cicullata
Pseudosaldius conjunctus
Leptoladustes densus
Xystus ater
Nedestes sarpedon
Orissus christophori
Camelodes leachii
Diorymerus lancifer
Dactylocrepis flabellitarsis
Pseudotorcus rufipes
Demoda vittata
Somenes regestus
Torcus variabilis
Cylindridia prolixa
Centrinopus alternatus
Nestrada compacta
Lorena simulans
Parasaldius longipes
Dialomia gradata
Limnobaris calandriformis
Eutoxus spp.
Palmocentrinus butia
Palmelampius heinrichi
Parisoschoenus spp.
Linonotus regalis
Nedestes sarpedon

Dimesus thoracicus
Centrinaspis spp.
Pycnotheantis spp.
Palistes spp.
Groatus spp.
Theantis spp.
Stegotes spp.
Stegotidius spp.


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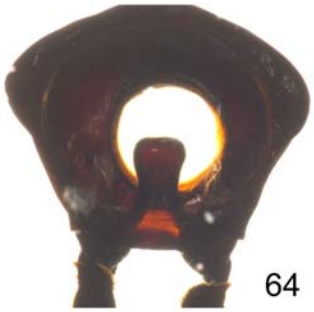

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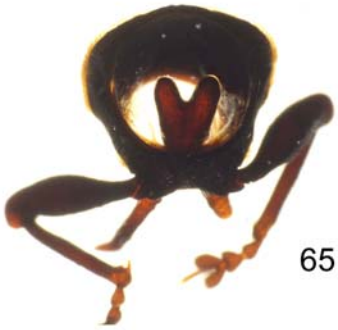

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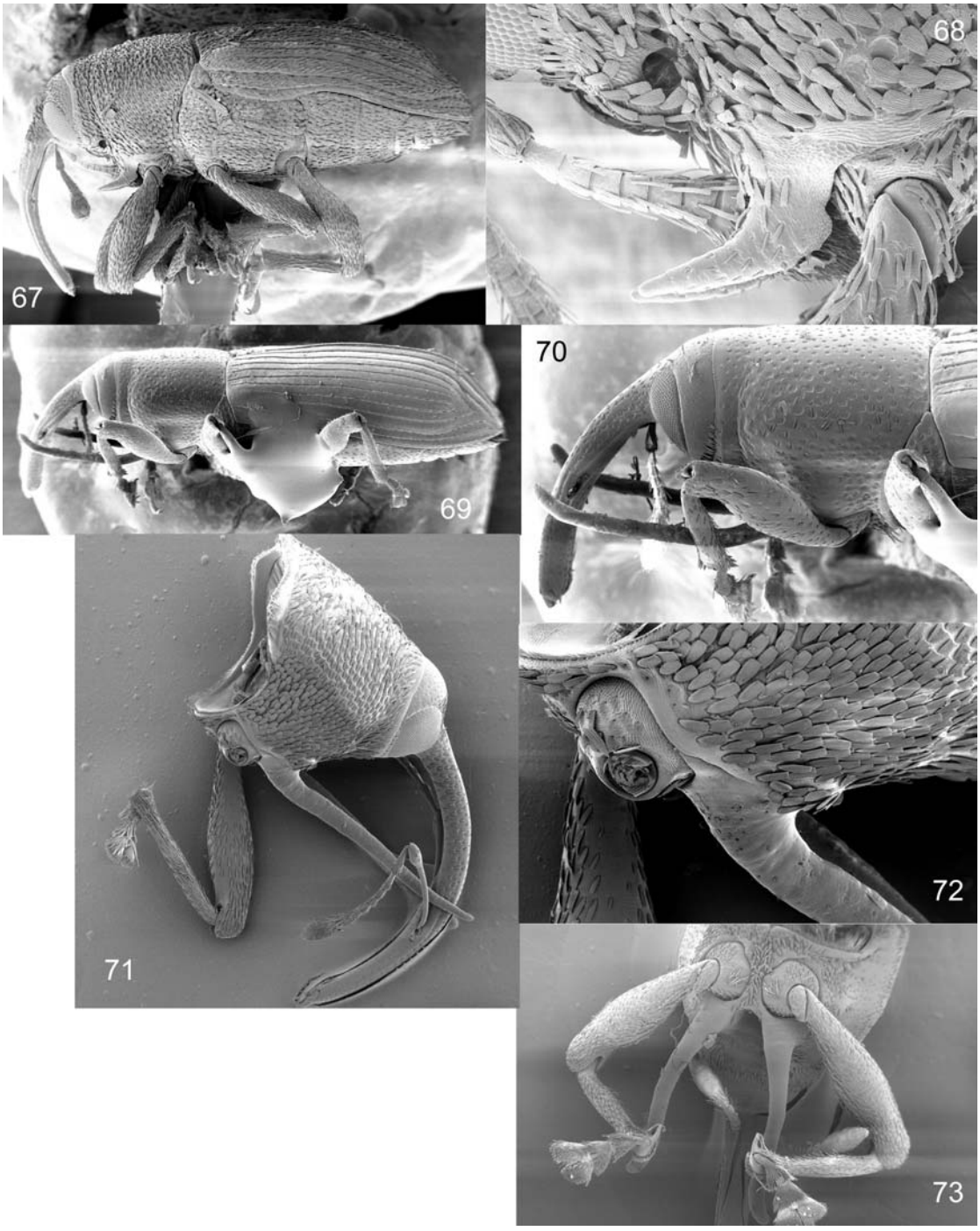
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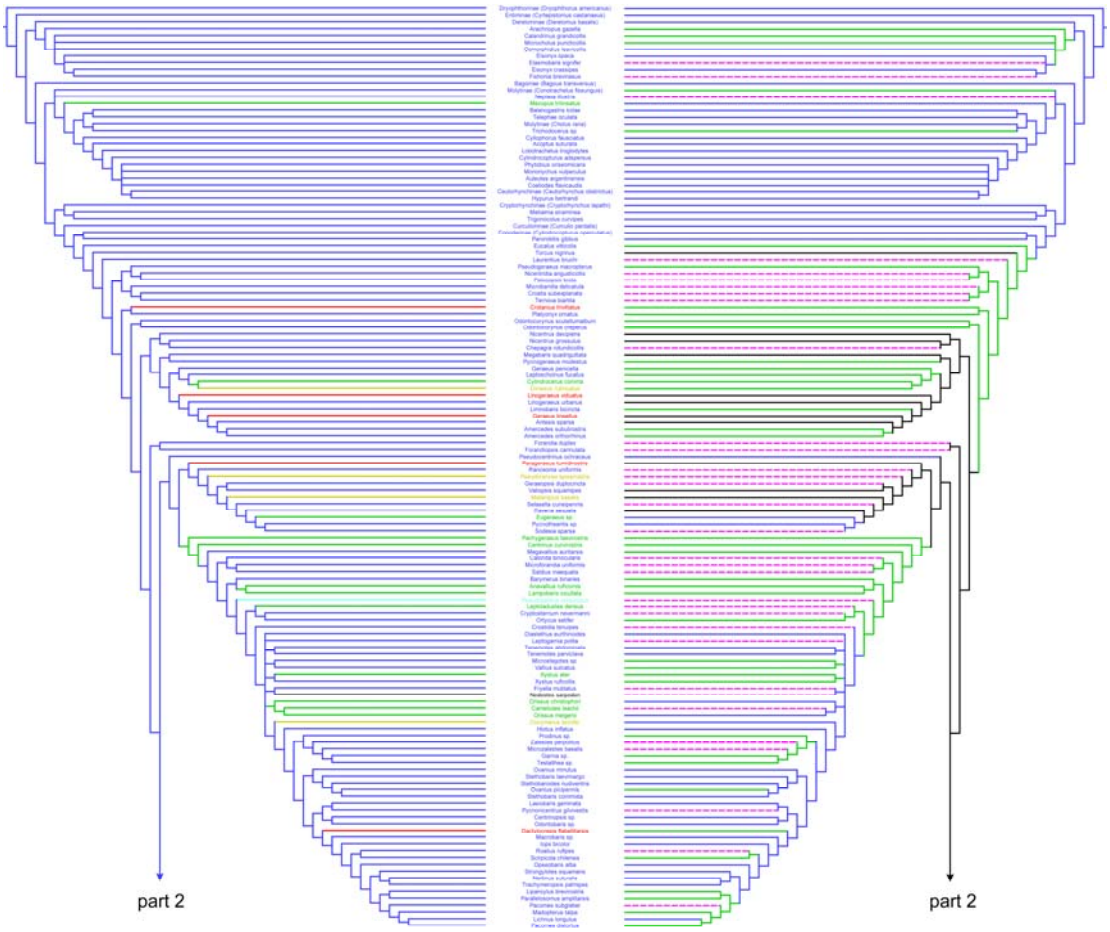

Pro-sternal horns in males:

- present, long, invagination reduced/absent
- present, long, invagination developed & bifurcate
- present, long, invagination developed & simple
- present, reduced, invagination reduced/absent
- present, fused, invagination developed & simple
- horns absent

Plectra on 7th tergite (in males):

- present, in dense columns
- present, in sparse columns
- plectra absent
- ambiguity

74


part 1
part 1
Pro-sternal horns in males:
present, long, invagination reduced/absent
present, long, invagination developed & bifurcate
present, long, invagination developed & simple
present, reduced, invagination reduced/absent
present, fused, invagination developed & simple
horns absent
Plectra on 7th tergite (in males):
present, in dense columns
present, in sparse columns
plectra absent
ambiguity
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Chapter IV: Sclerolepidia in baridine weevils (Coleoptera: Curculionidae)

Abstract

In a few families of Curculionoidea and within several subfamilies of Curculionidae, peculiarly modified scales are present along the suture between the metasternum and metepisternum. These scales are specifically known as sclerolepidia and their exact function remains unknown. Previous studies have broadly surveyed the presence of sclerolepidia in Curculionoidea (Lyal *et al*. 2006). The types of sclerolepidia present within Baridinae are described and illustrated in detail here, and the evolution of these types are traced on a phylogeny of Baridinae.

Keywords: modified scales, sensory receptors in insects, insect sutures.

Introduction

While conducting a phylogenetic analysis based on morphology and searching through the relatively small amount of literature on baridine weevils, it appears that there are many features of this group that yet await elucidation. Of these features are specialized scales, arranged linearly, along the suture between the metasternum and metepisternum. Through extensive examination of 231 of the 550 total genera presently included in Baridinae (Table 2), it was hypothesized that the presence of these scales, known as sclerolepidia, are a synapomorphy defining the subfamily.

However, upon examination of taxa outside of Baridinae, scales of similar structure were found in Cryptorhynchinae, Cossoninae, and Scolytidae. Sclerolepidia are also found in other subfamilies as well (Lyal *et al*. 2006). Although appearing similar to those found in Baridinae, the homology of sclerolepidia is uncertain due to their apparent sparse presence within Curculionoidea. Few weevil phylogenetic studies have utilized sclerolepidia as characters, and those that have (Kuschel 1995; Marvaldi *et al*. 2002) did so by only noting their absence or presence. The purpose of this study was to describe and characterize the presence and absence of sclerolepidia in weevils, particularly within the curculionid subfamily Baridinae. Their function and significance remain unknown.

Materials and methods

Of the 21 families included in Curculionoidea (Alonso-Zarazaga and Lyal 1999), 11 were examined for this study, and all of the 16 subfamilies included in Curculionidae were examined (Table 1). 231 of the 550 genera in Baridinae were examined. In total, 283 baridine species were examined. Digital photographs were taken using a Microptix photo system, and SEM images were captured using a LEO 1550 FESEM.

Description of sclerolepidia in Baridinae

All of the baridine genera studied possess sclerolepidia, thus it is hypothesized that probably all baridines have them. Two types of sclerolepidia are found in

Baridinae. Using the terminology of Lyal *et al*. (2006) they are the digitate (flat and small) and peg-like (projecting and large) types. From this study, the most common type in Baridinae is the digitate type, with the peg-like type present in fewer taxa. Although the digitate type is relatively uniform throughout all taxa that possess it, a few possess a form which is furcated more or has more digits, appearing feather-like (*Scirpicola chilensis*). Although the number and size of sclerolepidia present may be loosely associated with the density of scales present, nearly glabrous species may also possess many, large sclerolepidia, though the opposite usually is less common (densely convered with scales and possessing few, small sclerolepidia). As noted by Lyal *et al*., there often are holes or notches in the cuticle along the margin of the metepisternal suture below each sclerolepidion. This structural feature indicates that they may have a secretory function.

Evolution of sclerolepidia in Baridinae

As hypothesized by Lyal *et al*., it appears that the digitate type preceded the peg-like type in baridine evolution (Fig. 65). The peg-like type also seems not to be homologous among all of the taxa that possess it, indicating convergent evolution, in which several similar forms have arisen multiple times. This result also corroborates the hypothesis of Lyal *et al*. that sclerolepidia probably are not homologous among the Curculionidae due to their patchy distribution. It should also be noted, though, that there have been no phylogenetic hypotheses examining the distribution of the different types of sclerolepidia. Lyal *et al*. based their hypothesis of sclerolepidion

homology on the classification of Alonso-Zarazaga and Lyal (1999). According to the baridine phylogeny, it is unclear what sclerolepidion type is ancestral to Baridinae. Although the conoderine type preceeds Baridinae in the tree, it is a clade forming an independent evolutionary trajectory. However, due to lack of phylogenetic hypotheses for Conoderinae (and the majority of curculionid subfamilies), and its current polyphyletic structure, the sister-group of Baridinae remains uncertain, and thus the ancestral baridine sclerolepidion type also remains as such.

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Acknowledgements

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Figure captions

Figs. 1-8. 1-2, *Megavallius auritarsis*. 1, adult, lateral view; 2, enlargement of metepisternum. 3-4, *Amercedes subulirostris*. 3, adult, lateral view (SEM); 4, enlargement of metepisternum (SEM). 5-6, *Zygobarella zanthoxyli*. 5, thorax, lateral view; 6, enlargement of sclerolepidia. 7-8, *Stethobaroides nudiventris*. 7, metepisternum and sclerolepidia, dorsal view; 8, enlargement of sclerolepidia.

Figs. 9-16. SEM's. 9-15, *Pseudocentrinus ochraceus*. 9, adult, lateral view; 10, enlargement of metepisternum; 11-15, enlargements of sclerolepidia, dorsal view. 16, *Odontocorynus creperus*, metepisternum, lateral view.

Figs. 17-24. SEM's. 17, *Coleomerus boliviensis*, metepisternum, lateral view; 18, *Lipancylus brevirostris*, metepisternum, lateral view. 19-22, *Lydamis cinnamomeus*. 19, metepisternum, lateral view; 20, enlargement of sclerolepidia, lateral view; 21-22, enlargements of sclerolepidia, dorsal view. 23, *Baris torquata*, metepisternum, lateral view; 24, *Sibariops concurrens*, metepisternum, lateral view.

Figs. 25-32. SEM's. 25-26, *Geraeus lineellus*. 25, metepisternum, lateral view; 26, enlargement of sclerolepidia. 27, *Madarus bistrigellus*, metepisternum, lateral view; 28, *Cylindrocerus comma*, metepisternum, lateral view. 29-30, *Demoda vittata*. 29, metepisternum, lateral view; 30, enlargement of sclerolepidia. 31, *Amercedes subulirostris*, enlargement of sclerolepidia; 32, *Lixus concavus*, thorax, lateral view.

Figs. 33-40. 33, *Lixus concavus*, enlargement of metepisternum. 34-35, *Cholus rana*. 34, thorax, lateral view; 35, enlargement of metepisternum. 36-37, *Homoeolabus analis* (Attelabidae). 36, thorax, lateral view; 37, enlargement of suture between metasternum and metepisternum. 38-39, *Platypus parallelus* (Platypodinae). 38, thorax, lateral view; 39, enlargement of suture between metasternum and metepisternum. 40, *Apion longirostre* (Apionidae).

Figs. 41-48. SEM's, thorax, lateral view. 41, *Hypera punctata* (Hyperinae); 42-43, *Cossonus impressifrons* (Cossoninae). 42, thorax, lateral view; 43, enlargement of suture between metasternum and metepisternum. 44-45, *Hylurgops planirostris*

(Scolytinae). 44, thorax, lateral view; 45, enlargement of suture between metasternum and metepisternum. 46-49, *Cryptorhynchus lapathi* (Cryptorhynchinae). 46, thorax, lateral view; 47-48, enlargements of suture between metasternum and metepisternum.

Figs. 49-56. SEM's, thorax, lateral view. 49, *Cryptorhynchus lapathi* (Cryptorhynchinae), enlargements of suture between metasternum and metepisternum; 50, *Ceutorhynchus obstrictus* (Ceutorhynchinae); 51, *Curculio pardalis* (Curculioninae); 52, *Magdalis armicollis* (Mesoptilinae); 53, *Cyrtepistomus castanaeus* (Entiminae); 54, *Derelomus basalis* (Derelominae); 55-56, *Dryophthorus americanus* (Dryophthorinae). 55, thorax, lateral view; 56, enlargement of suture between metasternum and metepisternum.

Figs. 57-64. SEM's, thorax, lateral view. 57, *Bagous transversus* (Bagoinae); 58, *Cylindrocopturus operculatus* (Conoderinae); 59, *Rhodobaenus tredecimpunctatus* (Dryophthorinae); 60, *Eudiagogus pulcher* (Entiminae); 61, *Rhigopsis effracta* (Entiminae); 62, *Trigonorhinus* sp. (Anthribidae); 63, brentid sp. (Brentidae); 64, *Conotrachelus fissunguis* (Molytinae).

Fig. 65. Strict consensus tree with sclerolepidia character mapped onto it.

Fig. 65 (continued). Strict consensus tree with sclerolepidia character mapped onto it.

Table 1. List of taxa examined within Curculionoidea (not including those examined in Baridinae). * = list of taxa found in Table 2.

Family	Subfamily	Taxon	Metepisternal scales present?
Curculionidae	Conoderinae	*Cylindrocopturus operculatus*	-
		Pseudopiazurus centraliamericanus Heller	-
	Orthognathinae	*Rhodobaenus tredecimpunctatus*	-
	Entiminae	*Eudiagogus pulcher*	-
		Eupagoderes argentatus	-
		Rhigopsis effracta Lec.	-
		Cydianerus sp.	-
		Holonychus aeruginsus Fahr.	-
		Exophthalmus verecundus Chev.	-
		Otiorrhynchus morio Fabricius	-
		Compsus argyreus L.	-
		Cyrtepistomus castanaeus	-

Lixinae	*Lixus concavus* Say	-
	Cyphocleonus sp.	-
Cyclominae	*Listronotus scapularis* Casey	-
	Chrysolophus spectabilis	-
Cryptorhynchinae	*Cophes texanus* Sleeper	-
	Macromerus bicinctus Champion	-
	Coelosternus leporinus Champion	-
	Cryptorhynchus melastomae Champion	X
	Cryptorhynchus lapathi	X
Ceutorhynchinae	*Ceutorhynchus obstrictus* Marsh	-
Molytinae	*Conotrachelus* sp.	X
	Conotrachelus fissunguis LeConte	X
	Cholus rana	-
	Homalinotus coriaceus Gyll.	-
	Hylobius abietis	-
Cossoninae	*Cossonus impressifrons* Boh.	X
Curculioninae	*Curculio pardalis*	-

	Mesoptilinae	*Magdalis armicollis* Say	-
	Hyperinae	*Hypera punctata* Fab.	-
	Rhyncophorinae	*Dynamis borassi* Fab.	-
	Derelominae	*Derelomus basalis*	-
	Bagoinae	*Bagous transversus*	-
	Baridinae*		X
Dryophthoridae	Dryophthorinae	*Dryophthorus americanus*	-
Eurhynchidae		*Aporhina bispinosus* Boisd.	-
Ithyceridae		*Ithycerus noveboracensis* Forster	-
Attelabidae	Attelabinae	*Homoeolabus analis* Illiger	-
Platypodidae	Platypodinae	*Platypus parallelus* Fab.	-
Apionidae	Apioninae	*Apion longirostre* Oliver	-
Anthribidae	Anthribinae	*Trigonorhinus* sp.	-
Scolytidae	Scolytinae	*Hylurgops planirostris* Chapius	X
Brentidae		Brentid sp.	-
Brachyceridae	Brachycerinae	*Brachyceris granosus* Gyll.	-

Table 2. List of taxa examined within Baridinae (following Alonso-Zarazaga and Lyal 1999). All taxa examined possess metepisternal scales.

Tribe	Subtribe	Taxon
Baridini	Baridina	*Baris torquata*
		Elasmobaris signifer
		Pseudobaris angusta
		Plesiobaris albilata
		Desmoglyptus arizonicus
		Dissopygus metallescens
		Rhoptobaris canescens
		Rhaptinus torquatus
		Stereobaris interpunctata
		Solenosternus dividuus
		Busckiella lecythidis
		Orthoris crotchii
		Odontobaris sp.
		Macrobaris sp.
		Lepidobaris acnisti
	Coelonertina	*Coelonertus nigrirostris*
	Coleomerina	*Coleomerus boliviensis*
	Diorymerina	*Diorymerus lancifer*
		Prodinus sp.
	Eurhinina	*Eurhinus festivus*
		Eurhinus aeneus
Ambatini		*Embates chaetopus*
		Pteracanthus smidtii
Anopsilini		*Anopsilus oblongus*
Madarini	Madarina	*Orchidophilus aterrimus*
		Madarus bistrigellus
		Conoproctus quadripustulatus
		Glyptobaris lecontei
		Linomadarus vorticosus
		Madarellus laticollis
		Microrhinus mutilus
		Onychobaris densa
		Solaria curtula
	Barymerina	*Barymerus binaries*
	Eutoxina	*Eutoxus* sp.
	Leptoschoinina	*Loboderes citriventris*
		Leptoschoinus fucatus
		Athesapeuta vinculata
		Eumycterus albosquamulatus
		Megabaris quadriguttata
		Microstrates cocois
		Platyonyx ornatus
		Zena virgata
	Tonesiina	*Antesis sparsa*
		Myctides imberbis

		Pycnotheantis sp.
		Parisoschoenus sp.
Nertinini		*Nertinus suturalis*
		Strongylotes squamans
		Lichnus longulus
Optatini		*Lydamis cinnamomeus*
		Optatus palmaris
		Telemus sp.
		Pardisomus biplagiatus
		Pistus galeatus
Pantotelini	Pantotelina	*Pantoteles tenuirostris*
	Cyrionychina	*Cyrionyx camelus*
Peridinetini		*Peridinetus cretaceous*
		Peridinetus irroratus
Madopterini	Madopterina	*Azygides* sp.
		Centrinopsis sp.
		Iasides sp.
		Lipancylus brevirostris
		Madopterus talpa
		Opseobaris alba
		Pacomes subglaber
		Parallelosomus amplitarsis
		Trachymeropsis palmipes
	Apostasimerina	*Apostasimerus* sp.
	Thaliabaridina	*Thaliabaris inermis*
	Torcina	*Anatorcus densus*
		Microtorcus tubulatus
		Paratorcus sp.
		Pseudotorcus rufipes
		Sibariops concinna
		Sibariops concurrens
		Sibariopsida docilis
		Torcobius sp.
		Torcus nigrinus
		Torcus variabilis
	Zygobaridina	*Acanthobaris* sp.
		Acentrinops brevicollis
		Amercedes subulirostris
		Anavallius ruficornis
		Andiblis seriata
		Aniops sculpturata
		Anotesiops obidosensis
		Apinocis deplanatus
		Barilepis griseus
		Barilepton filiforme
		Barinus bivittatus
		Buchananius striatus
		Calandrinus grandicollis
		Calorida binocularis
		Camelodes leachii
		Camerones semiopacus
		Catapastinus caseyi
		Catapastus conspersus

Centrinites strigicollis
Centrinogyna hispidula
Centrinoides sp.
Centrinopus alternatus
Centrinus curvirostris
Chepagra rotundicollis
Clandius cephalotes
Crostidia tenuipes
Crostis subexplanata
Crotanius trivittatus
Cylindridia prolixa
Cylindrocerus comma
Dactylocrepis flabellitarsis
Dealia carbonarius
Deipyrus hirsutulus
Demoda vittata
Dericinus habilis
Dialomia gradata
Diastethus eurthinoides
Dimesus rubricatus
Diorymeropsis disjuncta
Diorymeropsis xanthoxyli
Dirabius calvus
Dirabius rectirostris
Eisonyx crassipes
Eisonyx opaca
Elliptobaris sp.
Ethelda squamosa
Eudialomia longula
Eugeraeus unifasciatus
Eusomenes curtirostris
Fishonia brevinasus
Forandia duplex
Forandiopsis carinulata
Fryella mutilatus
Garnia sp.
Geraeopsis duplocincta
Geraeus lineellus
Haplostethops ellipsoidea
Idiostethus subcalvus
Iops bicolor
Iopsidaspis truncatula
Ladustaspis crocopelmus
Ladustes sp.
Lamprobaris cicullata
Lasiobaris geminata
Laurentius bruchi
Leptogarnia polita
Leptoladustes densus
Limnobaris bicincta
Limnobaris calandriformis
Linogarnia suturalis
Linogeraeus urbanus

Linogeraeus viduatus
Liocentrinus sp.
Lissobaris nigropicea
Lissomenes sp.
Lorena simulans
Macrorevena atromicans
Megavallius auritarsis
Melampius basalis
Microbaridia delicatula
Microcholus puncticollis
Microcholus striatus
Microforandia uniformis
Microrevena sp.
Microstegotes sp.
Microzalestes basalis
Nedestes sarpedon
Neocratus sp.
Neplaxa illustris
Nestrada compacta
Nicentridia angusticollis
Nicentrus decipiens
Nicentrus grossulus
Odontocorynus scutellumalbum
Odontocorynus creperus
Oligolochus bracatus
Oligolochus ornatus
Oomorphidius leavicollis
Orissus meigenii
Ortycus cristosus
Ovanius picipennis
Ovanius minutus
Pachybaris porosa
Pachygeraeus laevirostris
Palocopsis tecta
Parafishonia setulosa
Parageraeus tumidirostris
Parasaldius sp.
Parasomenes curvirostris
Peclavia hispidicollis
Peclaviopsis planipectus
Phacelobarus signubaris
Plocamus echidna
Plocamus clavisetes
Pseudocentrinus ochraceus
Pseudogeraeus macropterus
Pseudorancea spissirostris
Pseudorthoris devexus
Pseudosaldius conjunctus
Psiona densa
Pycnogeraeus modestus
Pycnogeraeus striatirostris
Pycnonicentrus gilvivestis
Rancea parviclava

Ranceoma uniformis
Remertus marginatus
Revena sexualis
Reveniopsis sp.
Rhianinus niveiscutum
Roalius rufipes
Saldiopsis armata
Saldius inaequalis
Selasella cuneipennis
Sodesia sparsa
Somenes regestus
Spolatia gradata
Starcus rugulosus
Stethobaris commixta
Stethobaroides nudiventris
Stethobaropsis titara
Sunilius platyrhinhus
Tenemotes abdominalis
Tenemotes parviclava
Ternova biartita
Thestonia sparsa
Trichodirabius longulus
Valdenus laevis
Valiopsis squamipes
Vallius sulcatus
Xystus ater
Xystus ruficollis
Zaglyptoides sp.
Zalestes perpolitus
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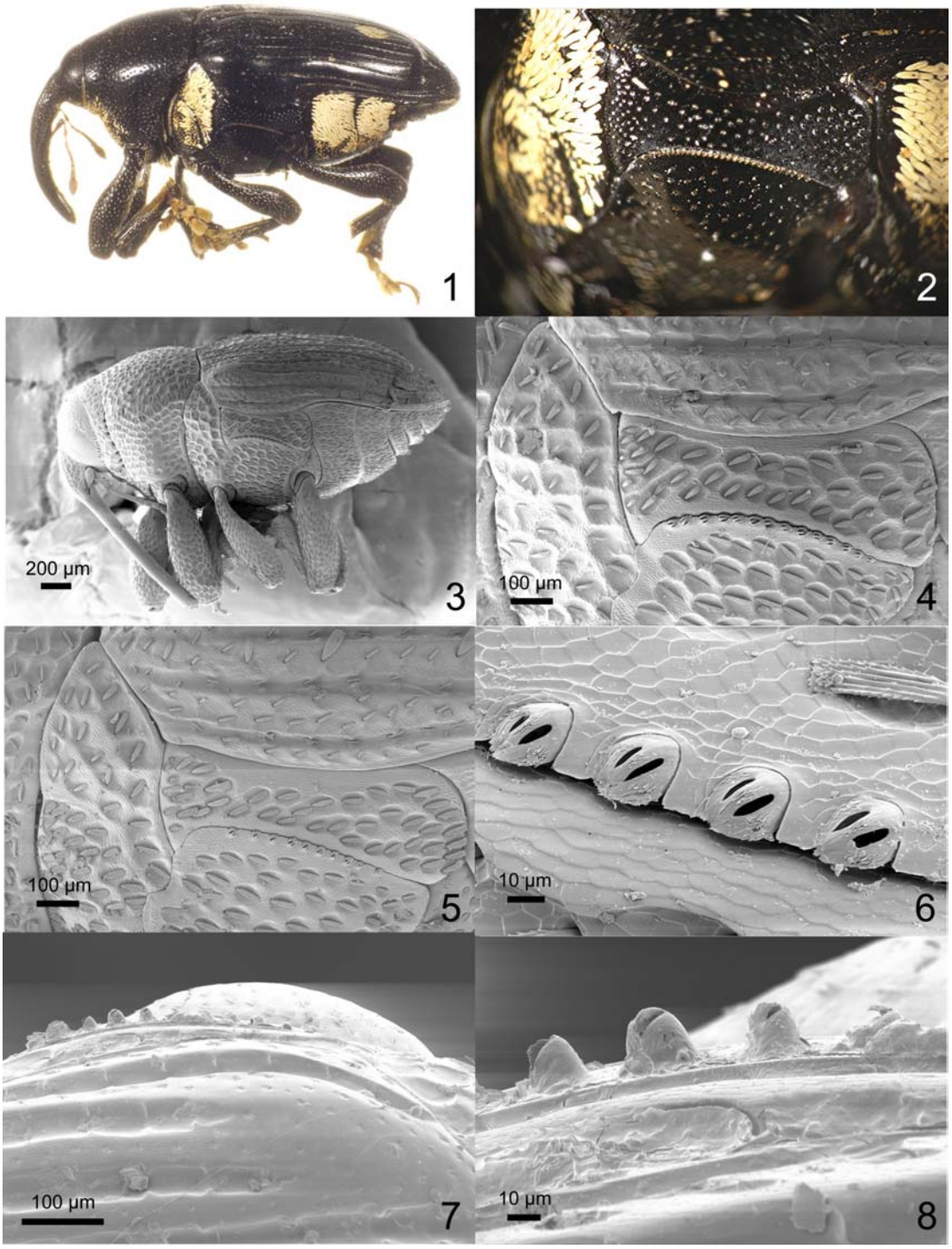
Zygobarella tristicula
Zygobarinus coelestinus
Zygobaris nitens
Zygozalestes oblongus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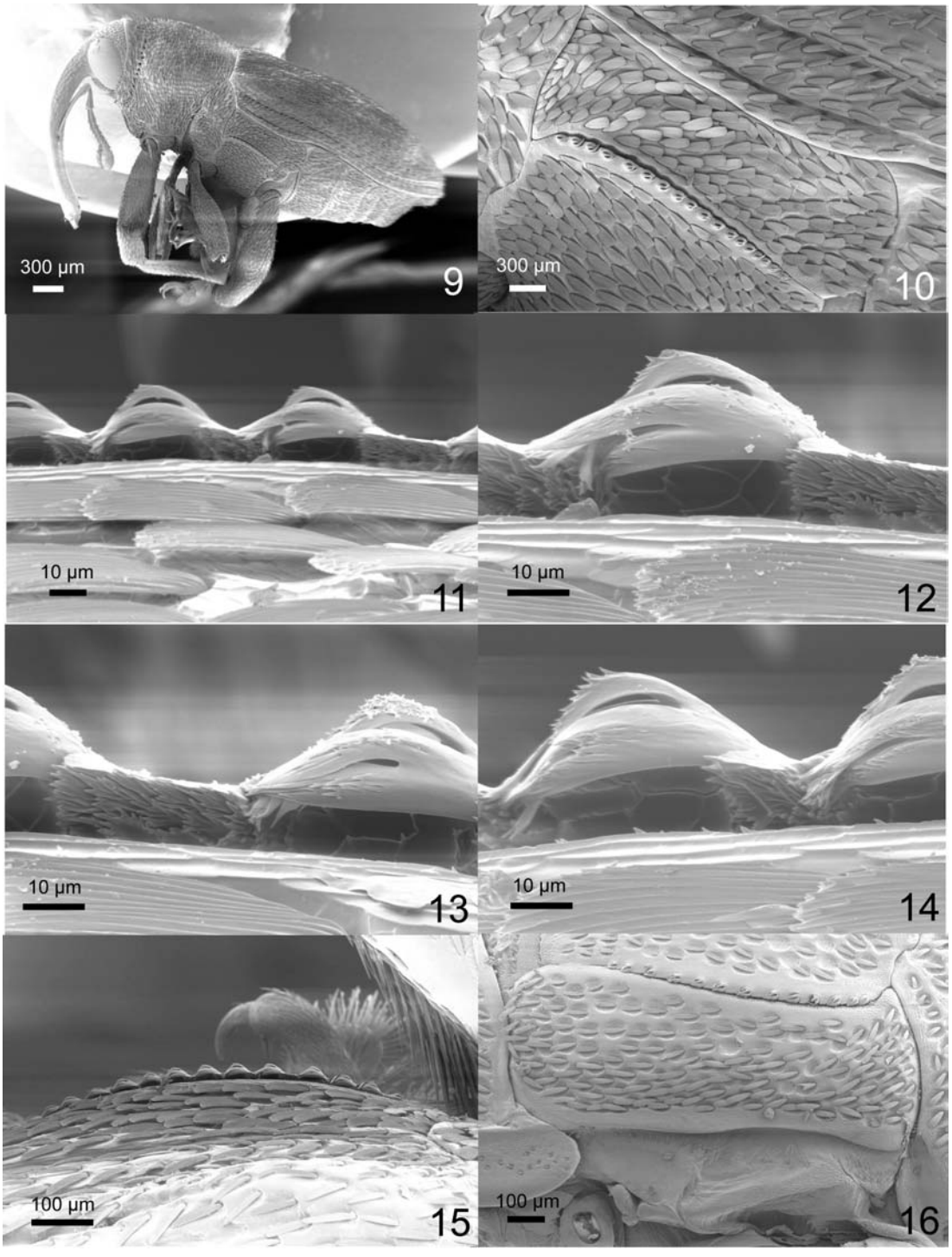
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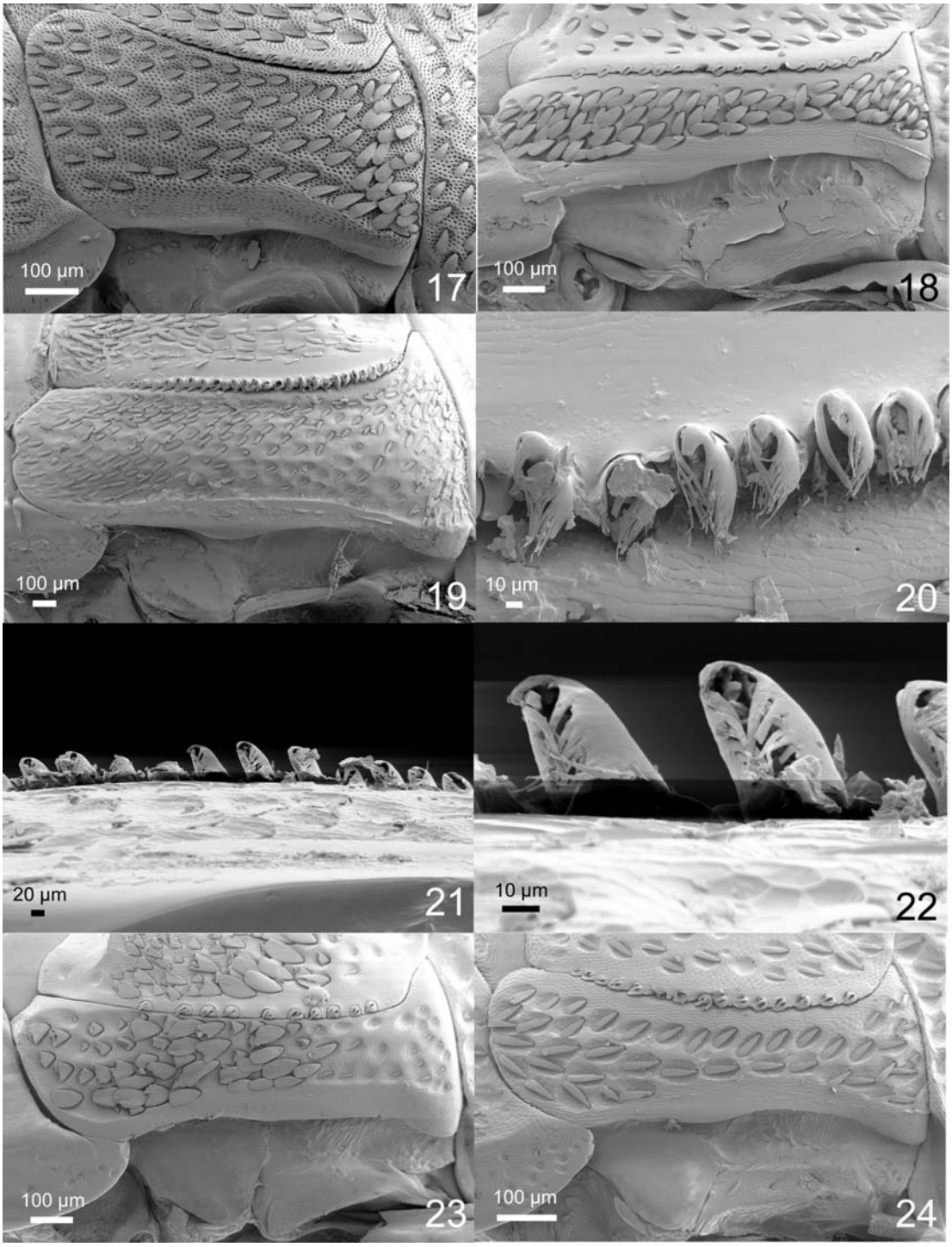
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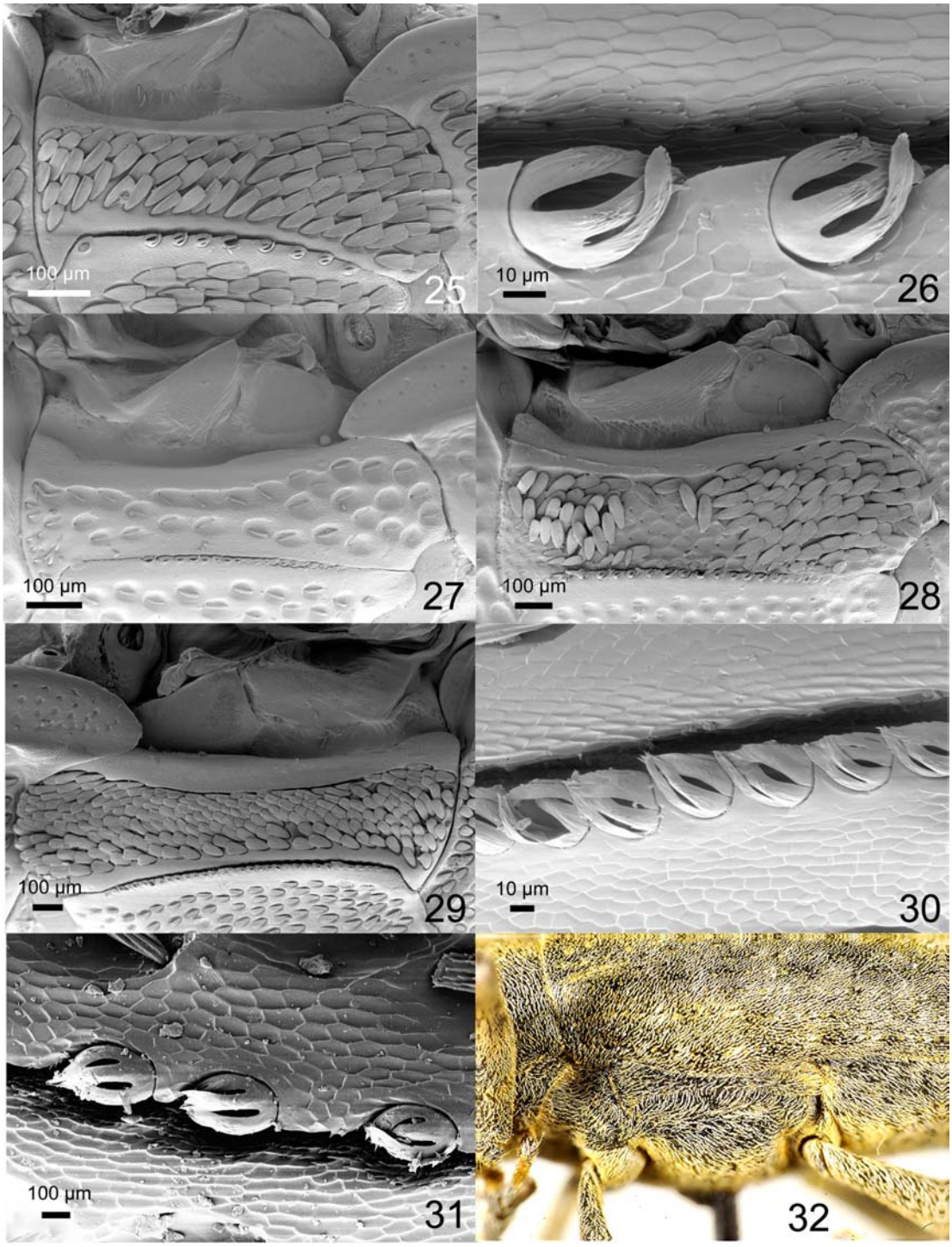
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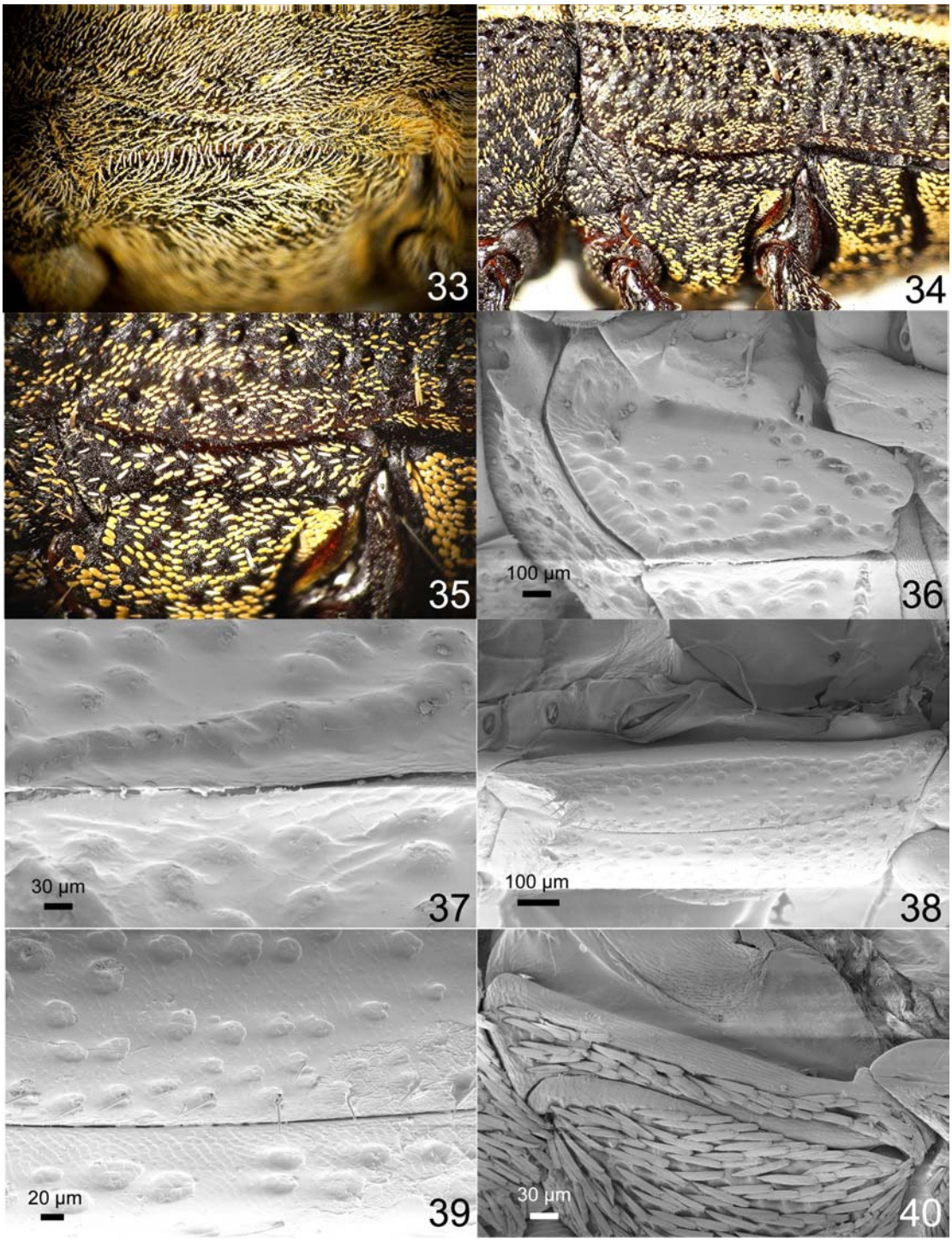
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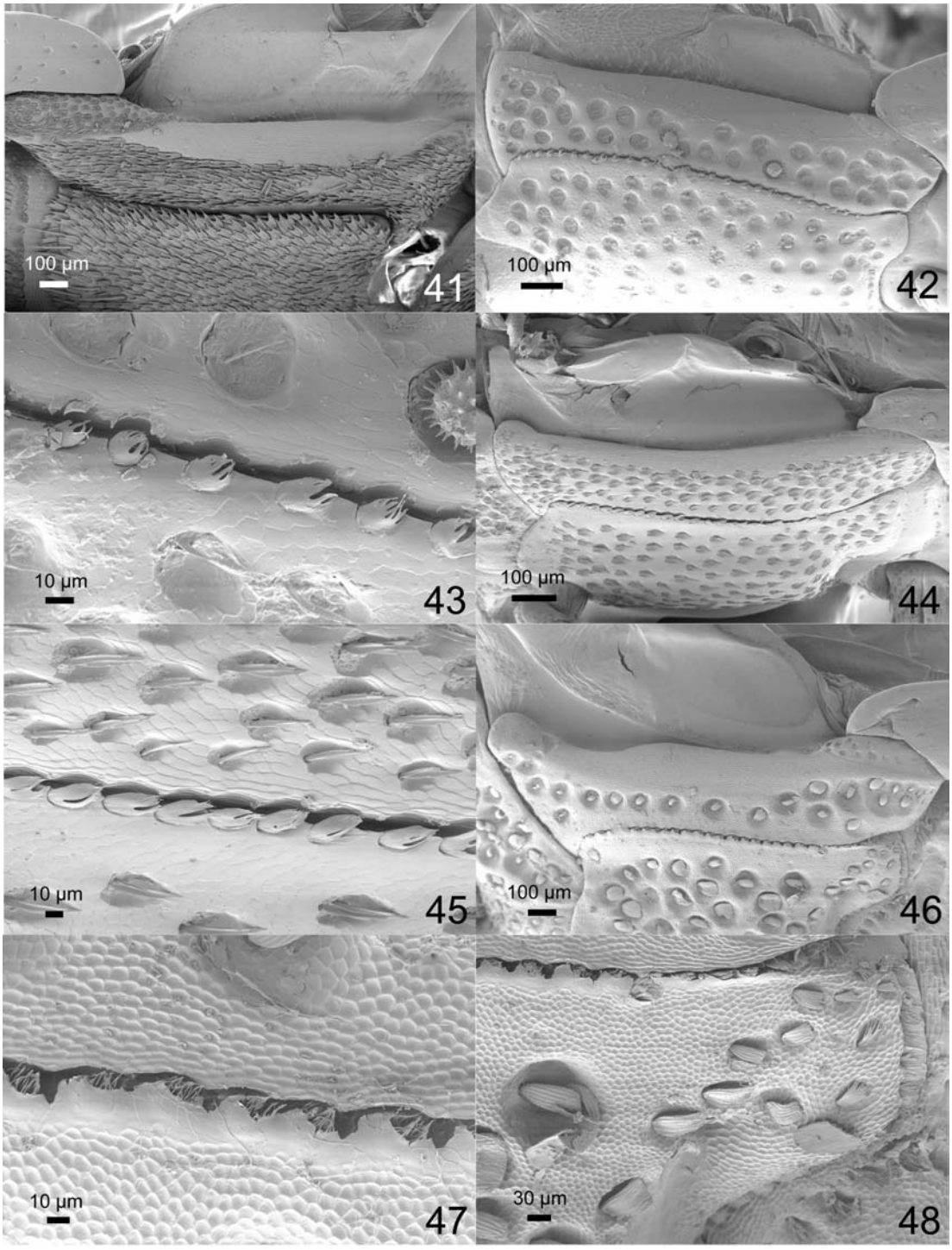
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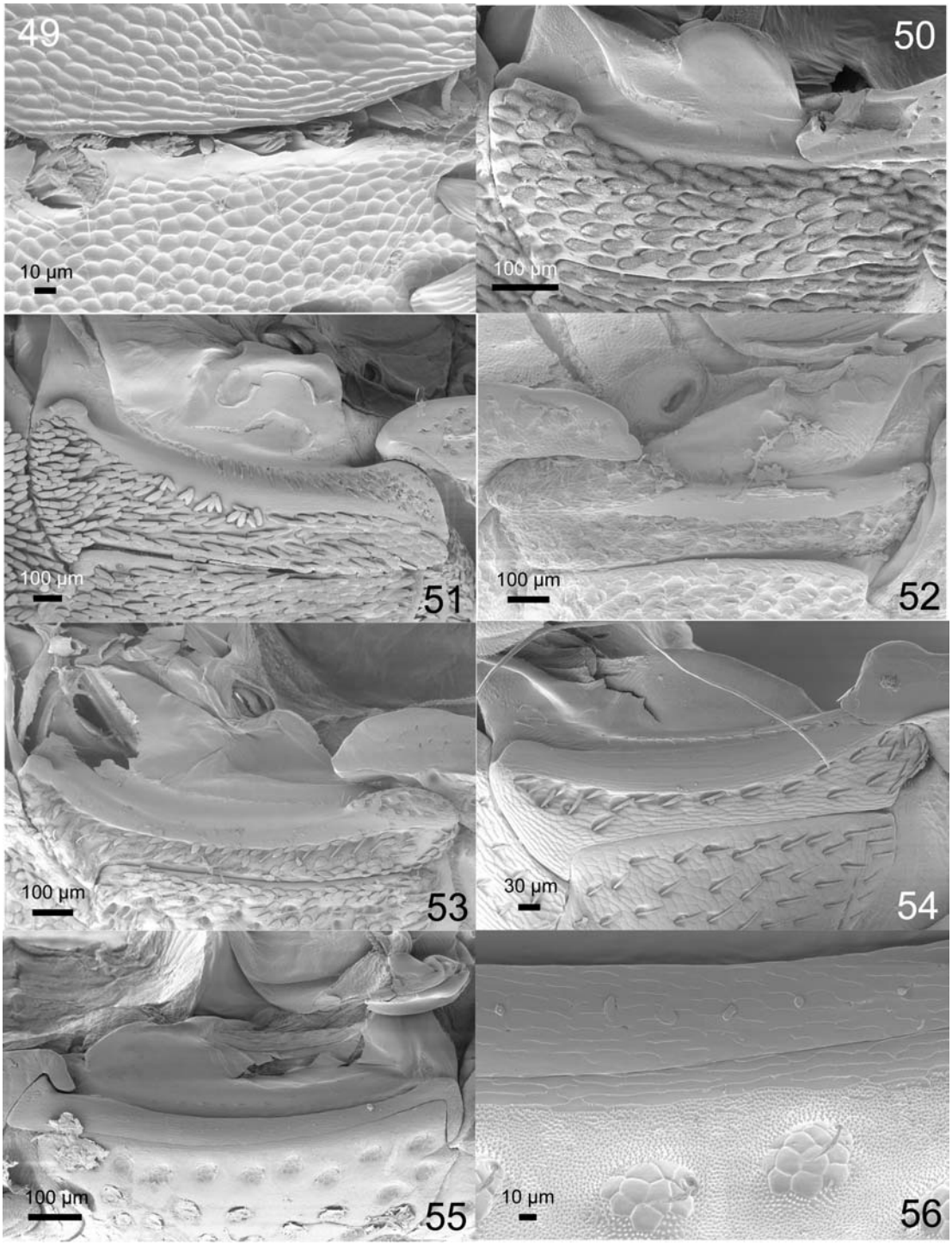
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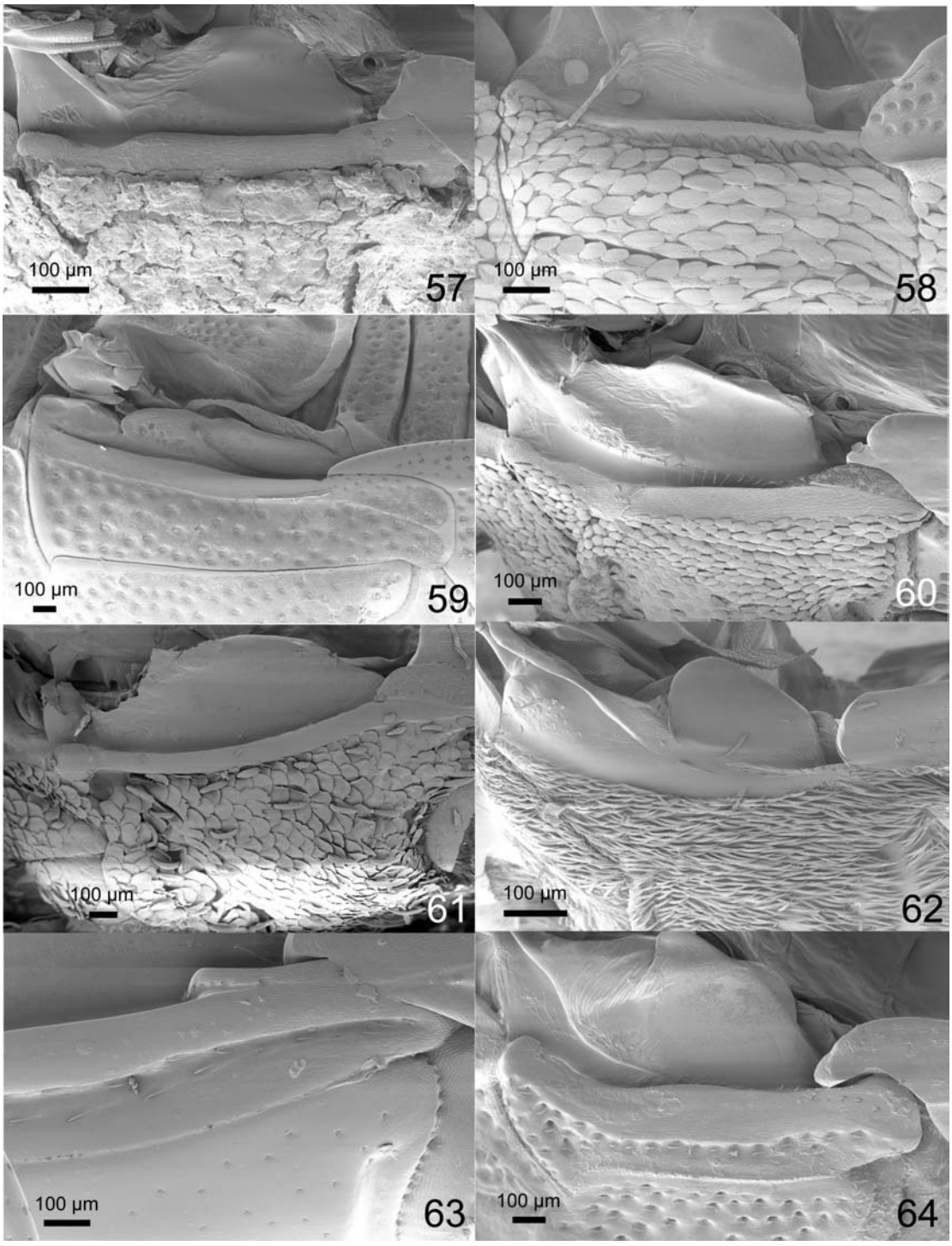
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Dryophthorinae (Dryophthorus americanus)
Entiminae (Cyrtepistomus castaneus)
Derelominae (Derelomus basalis)
Arachnopus gazella
Calandrinus grandicollis
Microcholus punctipollis
Oomorphidius leavicollis
Eisonyx opaca
Elasmobaris signifer
Eisonyx crassipes
Fishonia brevinasus
Bagoinae (Bagous transversus)
Molytinae (Conotrachelus fissunguis)
Neplaxa illustris
Mecopus trilineatus
Balanogastris kolae
Telephae oculata
Molytinae (Cholus rana)
Trichodocerus sp.
Cyllophorus fausciatus
Acoptus suturalis
Lobotrachelus troglodytes
Cylindrocopturus adspersus
Phytobius oriseomicans
Mononychus vulpeculus
Auleutes argentinensis
Coelodes flavicaudis
Ceutorhynchinae (Ceutorhynchus obstrictus)
Hypurus bertrandi
Cryptorhynchinae (Cryptorhynchus lapathi)
Metialma straminea
Trigonocolus curvipes
Curculioninae (Curculio pardalis)
Conoderinae (Cylindrocopturus operculatus)
Pararobitis gibbus
Eucalus vitticolis
Torcus nigrinus
Laurentius bruchi
Pseudogeraeus macropterus
Nicentridia angusticollis
Palocopsis tecta
Microbaridia delicatula
Crostis subexplanata
Ternova biartita
Crotanius trivittatus
Platyonyx ornatus
Odontocorynus scutellumalbum
Odontocorynus creperus
Nicentrus decipiens
Nicentrus grossulus
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Megabaris quadriguttata
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Linogeraeus urbanus
Limnobaris bicincta
Geraeus lineellus
Antesis sparsa
Amercedes subulirostris
Amercedes orthorhinus
Forandia duplex
Forandiopsis carinulata
Pseudocentrinus ochraceus
Parageraeus tumidirostris
Ranceoma uniformis
Pseudorancea spissirostris
Geraeopsis duplocincta
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Ravena sexualis
Eugeraeus sp.
Pycnotheantis sp.
Sodesia sparsa
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Centrinus curvirostris
Megavalius auritarsis
Calorida binocularis
Microforandia uniformis
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Barymerus binaries
Anavallius ruficornis
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Xystus ater
Xystus ruficollis
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Camelodes leachii
Orissus meigenii
Diorymerus lancifer
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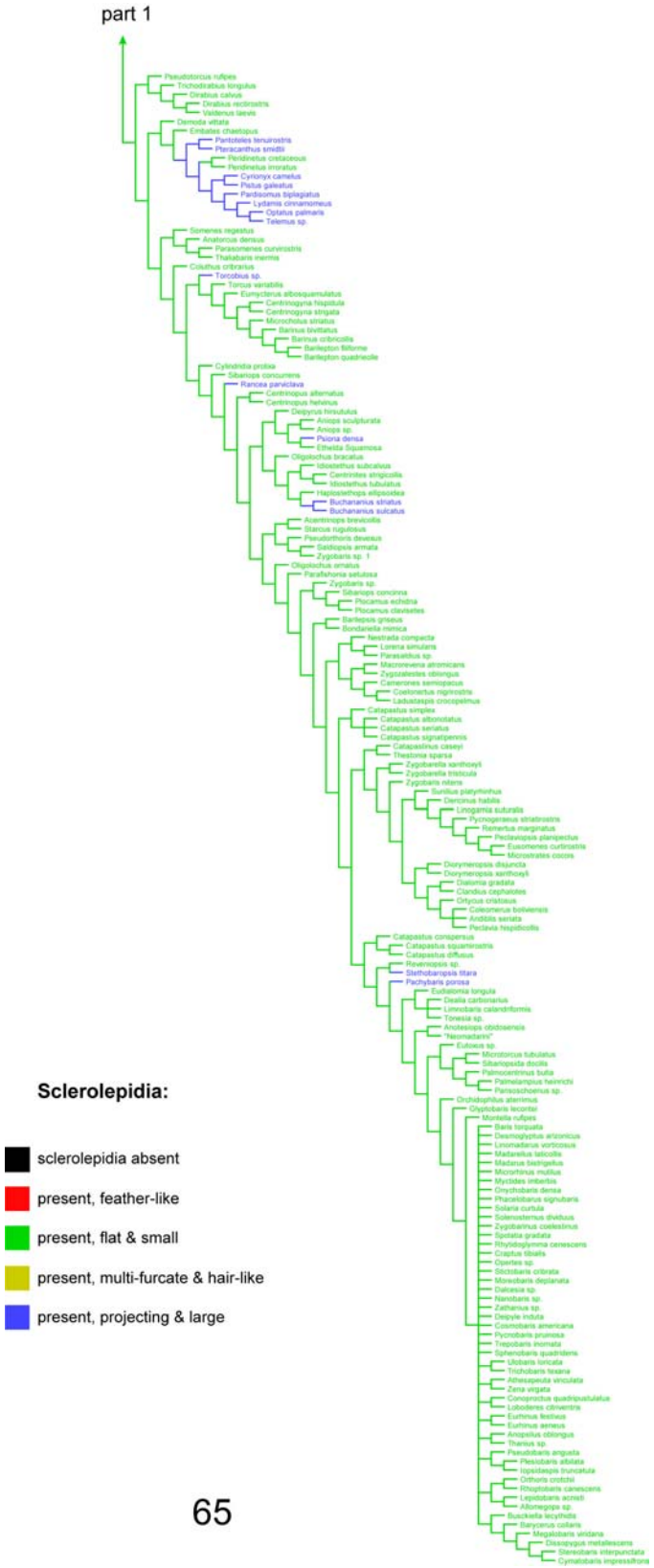
Roalius rufipes
Scirpicola chilensis
Opseobaris alba
Strongylotes squamans
Nertinus suturalis
Trachymeropsis palmipes
Lipancylus brevirostris
Parallelosomus amplitarsis
Pacomes subglaber
Madopterus talpa
Lichnus longulus
Pacomes distortus
Sclerolepidia:
sclerolepidia absent
present, feather-like
present, flat & small
present, multi-furcate & hair-like
present, projecting & large
65
part 2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Chapter V: Probabilistic fasteners and wing-locking mechanisms in baridine weevils (Coleoptera: Curculionidae)

Abstract

It is known that many groups of insects, such as beetles, fasten their elytra to the abdomen utilizing an array of friction-based locking mechanisms, cuticular outgrowths, and microstructures, such as microtrichia. Few studies have examined the ultrastructure of these morphological structures, and there has been no examination of these mechanisms in weevils. Considered one of the largest families of insects, with over 60,000 species described to date, exploration of weevil diversity is still in its infancy. Thus, an investigation of wing locking mechanisms in the subfamily baridinae has been carried out to further understand the morphological variation within this superdiverse insect group, to reveal the ultrastructure of these different mechanisms, and to compare some of the mechanisms found in weevils to those found within other insect groups.

Keywords: Parobolic elements, beetle ultrastructure, spiculate patches, wing-fastening.

Introduction

Insects employ a diverse array of cuticular outgrowths and attachment devices for various morphological and mechanical functions depending on the insect, such as for adhesion to surfaces, rapid mobilization and alert movements, and fastening and locking extremities. To accomplish these functions, various cuticular attachment systems have been developed, consisting of hooks, clamps, locks, and diverse frictional surfaces (Gorb *et al.* 2002).

Among the insect lineages that have convergently developed the ability to fasten their wings to the abdomen include the Lepidoptera, Diptera, Dermaptera, Hymenoptera, Heteroptera, and Coleoptera. Among the Coleoptera, and particularly in Baridinae (Coleoptera: Curculionidae), various modified frictional surfaces have evolved for fastening the fore- (elytra) and hind-wings to the abdomen. Known as probabilistic fasteners, these surfaces have modified setae and microtrichia that come together (Gorb 1999; Gorb *et al.* 2002; Gorb and Popov 2002). Although these surfaces do not converge with precise positioning, such as the teeth in zippers, they produce high frictional forces by converging less precisely, similar to the process by which the surfaces of velcro adhere, thereby forming a lock under a certain range of applied force and also permitting fast and easy attachment and detachment (Gorb and Popov 2002).

Although the presence of these microtrichia fields have been broadly surveyed and characterized in many beetle groups, there have been no previous studies examining them in weevils. The purpose of this study is to describe those wing-

fastening structures in the weevil subfamily Baridinae, and contrast them to those present outside of Baridinae.

Probabilistic wing fasteners in Baridinae

In Baridinae, cuticular outgrowths in the form of various modified microtrichia are present on the dorsal surface of the thorax (Figs. 28-87), the abdominal tergites (Figs. 1-5, 9-27, 88-136), the inner surface of the elytra (Figs. 137-216), and the dorsal and ventral surfaces of the hind wings at the folded state (Figs. 217-244). Those on the thorax are mostly of the lamellate type, in which broad, scale-like lamellae interlock (Fig. 7). Sometimes, as on the elytra, these lamellae bear digitiform or lobe-like processes along their apical margin. The microtrichia on the abdominal tergites and spiracular sclerites are the most impressive and developed, forming large patches of large, dense spines from tergites 1-7, although they are most notable on tergites 4-7. These spiculate patches on the abdominal tergites and spiracular sclerites have corresponding patches on the inner surface of the elytra. When these two surfaces, composed of spiniform probabilistic fasteners (Fig. 6), come in contact they lock due to high frictional forces. Because the hind-wings cover most of the abdomen when folded (Figs. 1, 2, 4), only the microtrichial patches on the spiracular sclerites and tergite 7 come in contact with the elytra during rest. Although tergite 7 is the only one to interlock with the elytra during rest, the spiculate patches on tergites 5 and 6 often are well-developed as well for reasons unknown. In order to allow the hind-wings to lay securely fastened over the abdomen, microtrichia are

present along the costal region and ventral region (when folded) on the hind wings. The microtrichia along the center region on tergites 1-6 are also oriented in a different direction than those present along the spiracular sclerites and tergite 7, most likely facilitating the re-opening of the hind-wings during flight.

Also present on tergite 7 of the abdomen of many genera in Baridinae are plectral tubercles (Figs. 88, 90, 94-95, 98, 105, 121, 123-124, 126, 130-131), which stridulate against a file of different forms on the inner apex of the elytra (Figs. 137, 140-141, 146, 156, 184, 192), as shown by the model (Fig. 8). Although mainly used for sound production and communication (Lyal and King 1996), it is also believed that these stridulating structures can also perform some function in fastening the elytra to the abdomen, as they also serve as a type of probabilistic fastener, albeit a weak one.

Probabilistic wing fasteners outside of Baridinae

Other subfamilies in Curculionidae, outside of Baridinae, possess similar wing-fastening structures on the tergites, thorax, elytra, and hind wings. Those in Baridinae, however, tend to be less developed. For instance, the spiculate patches on the tergites usually are present in most other subfamilies, if not all, and they typically are relatively large. The patches in Baridinae, though, often are smaller. This size reduction in spiculate patches may be correlated with the increased sclerotization of the tergites in the majority of Baridinae. If the surfaces of the tergites and the ventral

side of the elytra make complete contact, as they do in Baridinae as a result of the rigid tergites, then it is probably that a smaller surface area of spicules is needed to arrest the elytra and flight wings. In the other curculionid subfamilies, which possess relatively weakly sclerotized tergites, the surfaces of the tergites and elytra may not meet as completely as they do in Baridinae, thus requiring a greater surface area of spicules to arrest the elytra and flight wings.

The microtrichia fields present on the thorax, and particularly on the metascutum, of other curculionids typically are less developed than those in Baridinae. The metascutum in Baridinae is somewhat more defined and larger than that in other subfamilies, which possibly creates a better contact surface for the elytra.

The microtrichia fields on the apico-ventral surface of the elytra and on the hind wings are similar throughout Curculionidae. Although many differences are present, there appear to be no general differences between Baridinae and other curculionids.

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Figure captions

Figs. 1-8. 1-5, *Anthinobaris dispilota*, adult views. 1, dorsal view with left elytron removed; 2, dorsal view with elytra and left hind wing removed; 3, dorsal view with elytra and hind wings removed; 4, lateral view with elytra removed; 5, lateral view with elytra and hind wings removed. 6-8, wing-locking models. 6, model depicting the fastening of two surfaces covered with spines; 7, model depicting the fastening of two surfaces covered with lamelliform projections; 8, model depicting the weak fastening of two surfaces involved in stridulation, one surface with plectra, the other with a file.

Figs. 9-16. Abdominal views, dorsal and lateral (SEM's). 9, *Anthinobaris* sp., dorsal view; 10, *Odontocorynus creperus*, dorsal view; 11, *Odontocorynus creperus*, lateral view; 12-13, *Coleomerus boliviensis*. 12, dorsal view; 13, lateral view; 14-15, *Lipancylus brevirostris*. 14, dorsal view; 15, lateral view; 16, *Lydamis cinnamomeus*, dorsal view.

Figs. 17-24. Abdominal views, dorsal and lateral (SEM's). 17, *Lydamis cinnamomeus*, lateral view; 18-19, *Baris torquata*. 18, dorsal view; 19, lateral view; 20-21, *Sibariops concurrens*. 20, dorsal view; 21, lateral view; 22-23, *Geraeus lineellus*. 22, dorsal view; 23, lateral view; 24, *Madarus bistrigellus*, dorsal view.

Figs. 25-31. 25-27, abdominal views, dorsal and lateral (SEM's). 25, *Madarus bistrigellus*, lateral view; 26-27, *Cylindrocerus comma*. 26, dorsal view; 27, lateral

view. 28-31, *Demoda vittata*. 28, lateral view; 29, enlargement of metepisternum and surrounding area; 30, enlargement of spiculate patch above metepisternum; 31, enlargement of area anterior of spiculate patch.

Figs. 32-39. SEM's of thorax. 32-34, *Demoda vittata*. 32, dorsal view; 33, enlargement of right metascutum; 34, enlargement of right margin of right metascutum and dorsal aspect of metepisternum. 35-38, *Anthinobaris* sp. 35, thorax, lateral view; 36, enlargement of spiculate patch above metepisternum; 37, enlargement of left metascutum; 38, enlargement of spiculate patch on metascutum; 39, *Odontocorynus creperus*, enlargement of metepisternum and surrounding area.

Figs. 40-47. SEM's of thorax. 40-44, *Odontocorynus creperus*. 40, enlargement of spiculate patch above metepisternum; 41, enlargement of hind wing base region (anterior of metepisternal spiculate patch), lateral view; 42, enlargement of left metascutum; 43, enlargement of spiculate patch on metascutum; 44, enlargement of left margin of left metascutum and dorsal aspect of metepisternum. 45-47, *Coleomerus boliviensis*. 45, enlargement of metepisternum and surrounding area; 46, enlargement of spiculate patch above metepisternum; 47, enlargement of hind wing base region (anterior of metepisternal spiculate patch), lateral view.

Figs. 48-55. SEM's of thorax. 48-49, *Coleomerus boliviensis*. 48, enlargement of left metascutum; 49, enlargement of left margin of left metascutum and dorsal aspect

of metepisternum. 50-54, *Lipancylus brevirostris*. 50, enlargement of metepisternum and surrounding area; 51, enlargement of spiculate patch above metepisternum; 52, enlargement of area anterior of spiculate patch; 53, enlargement of left metascutum; 54, enlargement of left margin of left metascutum and dorsal aspect of metepisternum; 55, *Lydamis cinnamomeus*, enlargement of metepisternum and surrounding area.

Figs. 56-63. SEM's of thorax. 56-59, *Lydamis cinnamomeus*. 56, enlargement of spiculate patch above metepisternum; 57, enlargement of area anterior of spiculate patch; 58, enlargement of left metascutum; 59, enlargement of left margin of left metascutum and dorsal aspect of metepisternum. 60-63, *Baris torquata*. 60, enlargement of metepisternum and surrounding area; 61, enlargement of spiculate patch above metepisternum; 62, enlargement of hind wing base region (anterior of metepisternal spiculate patch), lateral view; 63, enlargement of left metascutum.

Figs. 64-71. SEM's of thorax. 64-69, *Sibariops concurrens*. 64, enlargement of metepisternum and surrounding area; 65, enlargement of hind wing base region (anterior of metepisternal spiculate patch), lateral view; 66, enlargement of anterior pleural region (lateral view), showing the first spiracle; 67, enlargement of left metascutum; 68, enlargement of spiculate patch on metascutum; 69, enlargement of left margin of left metascutum and dorsal aspect of metepisternum. 70-71, *Geraeus*

lineellus. 70, enlargement of metepisternum and surrounding area; 71, enlargement of spiculate patch above metepisternum.

Figs. 72-79. SEM's of thorax. 72-74, *Geraeus lineellus*. 72, enlargement of hind wing base region (anterior of metepisternal spiculate patch), lateral view; 73, enlargement of left metascutum; 74, enlargement of left margin of left metascutum and dorsal aspect of metepisternum; 75-78, *Madarus bistrigellus*. 75, enlargement of metepisternum and surrounding area; 76, enlargement of hind wing base region (anterior of metepisternal spiculate patch), lateral view; 77, enlargement of left metascutum; 78, enlargement of left margin of left metascutum and dorsal aspect of metepisternum; 79, *Cylindrocerus comma*, enlargement of metepisternum and surrounding area.

Figs. 80-87. SEM's of thorax. 80-82, *Cylindrocerus comma*. 80, enlargement of hind wing base region (anterior of metepisternal spiculate patch), lateral view; 81, enlargement of left metascutum; 82, enlargement of left margin of left metascutum and dorsal aspect of metepisternum. 83-87, *Demoda vittata*. 83, enlargement of metepisternum and surrounding area; 84, enlargement of spiculate patch above metepisternum; 85, enlargement of hind wing base region (anterior of metepisternal spiculate patch), lateral view; 86, enlargement of right metascutum; 87, enlargement of right margin of right metascutum and dorsal aspect of metepisternum.

Figs. 88-93. SEM's of abdomen. 88, *Zygobaris nitens*, apical tergites. 89-90, *Amercedes orthorrhinus*. 89, abdomen; 90, enlargement of apical tergites. 91-92, *Zygobarella tristicula*. 91, abdomen; 92, enlargement of apical tergites. 93, *Catapastus squamirostris*, abdomen.

Figs. 94-99. SEM's of abdomen. 94-95, *Catapastus squamirostris*. 94, enlargement of apical tergites; 95, enlargement of 7th tergite. 96, *Diorymeropsis disjuncta*, enlargement of apical tergites; 97-98, *Centrinogyna strigata*. 97, abdomen; 98, enlargement of 7th tergite. 99, *Odontocorynus creperus*, abdomen, lateral view.

Figs. 100-107. SEM's of abdomen. 100, *Odontocorynus creperus*, enlargement showing median and lateral spiculate patches. 101-102, *Coleomerus boliviensis*. 101, abdomen, lateral view; 102, enlargement showing median and lateral spiculate patches. 103-105, *Lipancylus brevirostris*. 103, abdomen, lateral view; 104, enlargement showing median and lateral spiculate patches; 105, enlargement of 7th tergite. 106-107, *Lydamis cinnamomeus*. 106, abdomen, lateral view; 107, enlargement showing median and lateral spiculate patches.

Figs. 108-113. SEM's of abdomen. 108-110, *Baris torquata*. 108, abdomen, lateral view; 109, enlargement showing median and lateral spiculate patches; 110, enlargement of 7th tergite. 111-113, *Sibariops concurrens*. 111, abdomen, lateral

view; 112, enlargement showing median and lateral spiculate patches; 113, enlargement of a lateral tergite, showing lateral spiculate patch.

Figs. 114-119. SEM's of abdomen. 114-115, *Geraeus lineellus*. 114, abdomen, lateral view; 115, enlargement showing median and lateral spiculate patches. 116-117, *Madarus bistrigellus*. 116, abdomen, lateral view; 117, enlargement showing median and lateral spiculate patches. 118-119, *Cylindrocerus comma*. 118, adbdomen, dorsal view; 119, enlargement of 6th and 7th tergites.

Figs. 120-127. SEM's of abdomen. 120-121, *Cylindrocerus comma*. 120, abdomen, lateral view; 121, enlargement showing median and lateral spiculate patches. 122-126, *Demoda vittata*. 122, abdomen, lateral view; 123, enlargement of plectra (lateral view); 124, enlargement of plectra (lateral view); 125, enlargement showing median and lateral spiculate patches; 126, enlargement of 7th tergite. 127, *Anthinobaris* sp., 7th tergite.

Figs. 128-133. SEM's of abdomen. 128, *Pertorcus* sp., abdomen (dorsal view); 129, *Acythopeus* sp., abdomen (dorsal view). 130-131, *Pycnogeraeus modestus*. 130, 7th tergite; 131, enlargement of 7th tergite. 132, *Anthinobaris* sp., abdomen (dorsal view); 133, *Taiwanobaris* sp., abdomen (dorsal view).

Figs. 134-139. 134-136, SEM's of abdomen. 134, *Taiwanobaris* sp., enlargement of 7th tergite; 135, *Acythopeus* sp., abdomen (dorsal view); 136, *Zena* sp., apical tergites. 137-139, SEM's of elytra. 137, *Zygobaris nitens*, enlargement of apex of elytron (ventral view). 138-139, *Amercedes orthorrhinus*. 138, elytron (ventral view); 139, enlargement of apex of elytron (ventral view).

Figs. 140-147. SEM's of elytra. 140, *Amercedes orthorrhinus*, enlargement of file at apex (ventral view); 141, *Idiostethus subcalvus*, enlargement of file at apex (ventral view). 142-144, *Centrinogyna strigata*. 142, elytron (ventral view); 143, enlargement of antero-lateral margin (ventral view); 144, enlargement of apex of elytron (ventral view). 145-146, *Diastethus eurthinoides*. 145, apex of elytron (ventral view); 146, enlargement of apex of elytron (ventral view). 147, *Trichodirabius longulus*, apex of elytron (ventral view).

Figs. 148-153. SEM's of elytra. 148, *Trichodirabius longulus*, enlargement of apex of elytron (ventral view); 149-151, *Odontocorynus creperus*. 149, elytron (ventral view); 150, enlargement of anterior of elytron (ventral view); 151, enlargement of apex of elytron (ventral view). 152-153, *Coleomerus boliviensis*. 152, elytron (ventral view); 153, enlargement of anterior of elytron (ventral view).

Figs. 154-161. SEM's of elytra. 154-156, *Coleomerus boliviensis*. 154, enlargement of antero-lateral margin (ventral view); 155, apex of elytron (ventral view); 156,

enlargement of apex of elytron (ventral view). 157-161, *Lipancylus brevirostris*. 157, elytron (ventral view); 158, enlargement of anterior of elytron (ventral view); 159, enlargement of antero-lateral margin (ventral view); 160, apex of elytron (ventral view); 161, enlargement of apex of elytron (ventral view).

Figs. 162-169. SEM's of elytra. 162-168, *Lydamis cinnamomeus*. 162, elytron (ventral view); 163, apex of elytron (ventral view); 164, enlargement of spiculate patch at apex; 165, enlargement of apex of elytron (ventral view); 166, enlargement of medial margin of elytron (ventral view); 167, enlargement of anterio-medial region of elytron (ventral view); 168, enlargement of anterio-lateral region of elytron (ventral view). 169, *Baris torquata*, elytron (ventral view).

Figs. 170-177. SEM's of elytra. 170-174, *Baris torquata*. 170, enlargement of anterior of elytron (ventral view); 171, enlargement of anterio-medial region of elytron (ventral view); 172, apex of elytron (ventral view); 173, enlargement of spiculate patch at apex; 174, enlargement of apex of elytron (ventral view). 175-177, *Sibariops concurrens*. 175, elytron (ventral view); 176, apex of elytron (ventral view); 177, enlargement of apex of elytron (ventral view).

Figs. 178-185. SEM's of elytra. 178, *Sibariops concurrens*, enlargement of anterior of elytron (ventral view). 179-184, *Geraeus lineellus*. 179, elytron (ventral view); 180, enlargement of anterior of elytron (ventral view); 181, enlargement of anterio-

lateral region of elytron (ventral view); 182, enlargement of anterio-medial region of elytron (ventral view); 183, apex of elytron (ventral view); 184, enlargement of apex of elytron (ventral view). 185, *Madarus bistrigellus*, elytron (ventral view).

Figs. 186-193. SEM's of elytra. 186-189, *Madarus bistrigellus*. 186, apex of elytron (ventral view); 187, enlargement of apex of elytron (ventral view); 188, enlargement of anterio-lateral region of elytron (ventral view); 189, enlargement of anterio-medial region of elytron (ventral view). 190-193, *Cylindrocerus comma*. 190, elytron (ventral view); 191, apex of elytron (ventral view); 192, enlargement of apex of elytron (ventral view); 193, enlargement of anterio-lateral region of elytron (ventral view).

Figs. 194-201. SEM's of elytra. 194, *Cylindrocerus comma*, enlargement of anterio-medial region of elytron (ventral view). 195-198, *Demoda vittata*. 195, elytron (ventral view); 196, enlargement of anterior of elytron (ventral view); 197, apex of elytron (ventral view); 198, enlargement of apex of elytron (ventral view). 199, *Anthinobaris* sp., apex of elytron (ventral view); 200-201, *Keibaris fortidens*. 200, apex of elytron (ventral view); 201, enlargement of spiculate patch at apex.

Figs. 202-209. SEM's of elytra. 202, *Keibaris fortidens*, enlargement of apex of elytron (ventral view). 203, *Pertorcus* sp., apex of elytron (ventral view); 204, *Phaenomerus* sp., apex of elytron (ventral view); 205, *Anthinobaris* sp., apex of

elytron (ventral view). 206-207, *Acythophanes* sp. 206, apex of elytron (ventral view); 207, enlargement of apex of elytron (ventral view). 208, *Anthinobaris* sp., apex of elytron (ventral view); 209, *Pycnogeraeus modestus*, apex of elytron (ventral view).

Figs. 210-217. SEM's of elytra. 210, *Silobaris* sp., apex of elytron (ventral view); 211-216, *Lixus concavus* (Lixinae). 211, enlargement of anterior of elytron (ventral view); 212, enlargement of anterio-medial region of elytron (ventral view); 213, enlargement of anterio-lateral region of elytron (ventral view); 214, apex of elytron (ventral view); 215, enlargement of apex of elytron (ventral view); 216, enlargement of spiculate patch at apex. 217, *Anthinobaris* sp., hind wing (dorsal view).

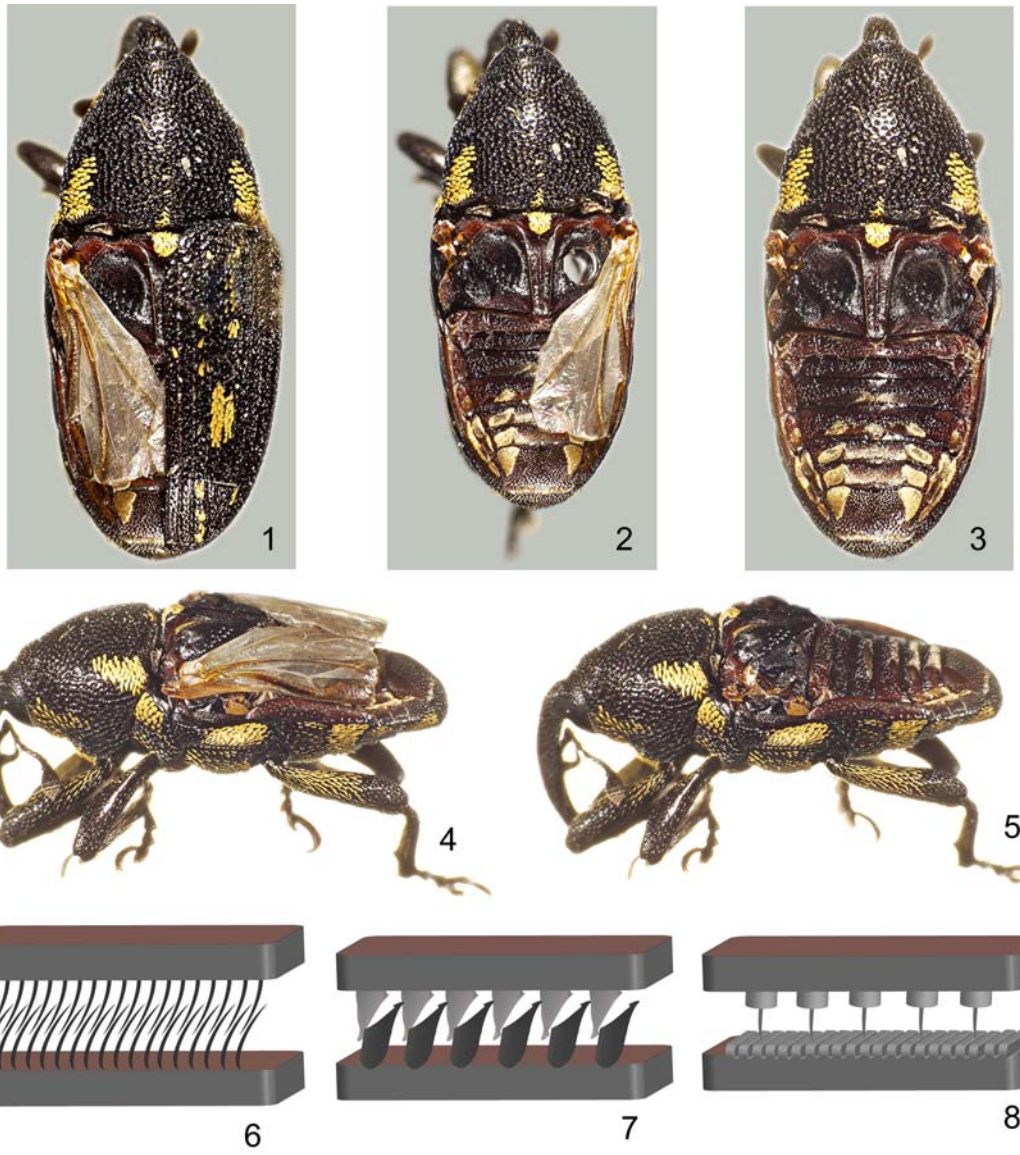
Figs. 218-225. SEM's of hind wings. 218-220, *Anthinobaris* sp. 218, enlargement of costal and radial area; 219, hind wing (ventral view); 220, enlargement of setae on terminal area of hind wing (ventral view). 221-223, *Odontocorynus creperus*. 221, enlargement of wing base (ventral view); 222, wing base (dorsal view); 223, enlargement of posterior margin of wing base (dorsal view). 224-225, *Coleomerus boliviensis*. 224, wing base (ventral view); 225, wing base (dorsal view).

Figs. 226-233. SEM's of hind wings. 226, *Coleomerus boliviensis*, enlargement of wing base (dorsal view). 227-228, *Lipancylus brevirostris*. 227, wing base (ventral view); 228, wing base (dorsal view). 229-231, *Lydamis cinnamomeus*. 229, wing

base (dorsal view); 230, enlargement of wing base (dorsal view); 231, wing base (ventral view). 232, *Baris torquata*, wing base (dorsal view); 233, *Sibariops concurrens*, wing base (ventral view).

Figs. 234-241. SEM's of hind wings. 234, *Sibariops concurrens*, wing base (dorsal view). 235-237, *Geraeus lineellus*. 235, wing base (dorsal view); 236, wing base (ventral view); 237, enlargement of wing base (ventral view). 238-240, *Madarus bistrigellus*. 238, wing base (ventral view); 239, wing base (dorsal view); 240, enlargement of costal region of wing base (dorsal view). 241, *Cylindrocerus comma*, wing base (ventral view).

Figs. 242-244. SEM's of hind wings. 242-243, *Cylindrocerus comma*. 242, enlargement of wing base (ventral view); 243, wing base (dorsal view); 244, *Demoda vittata*, wing base (dorsal view).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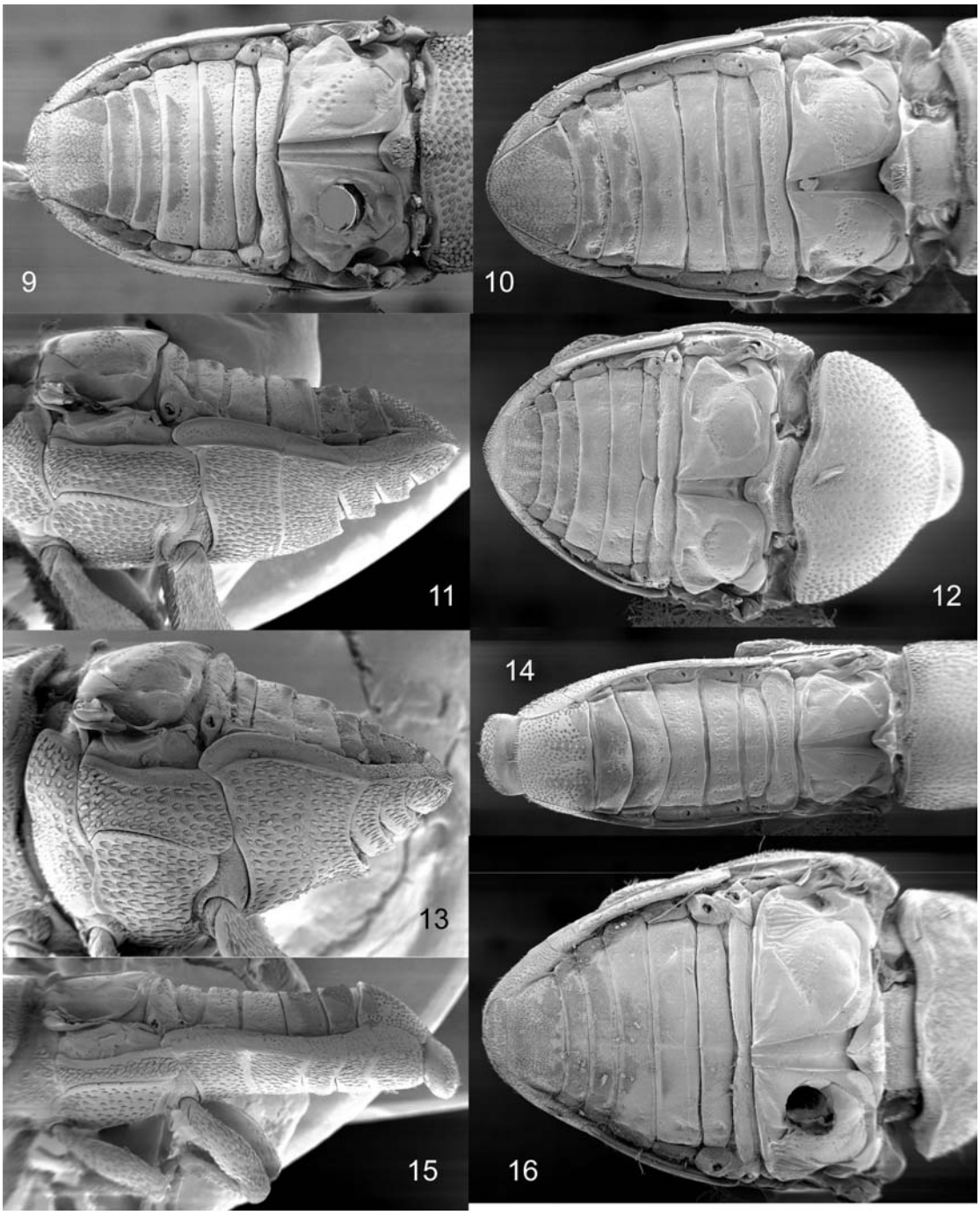
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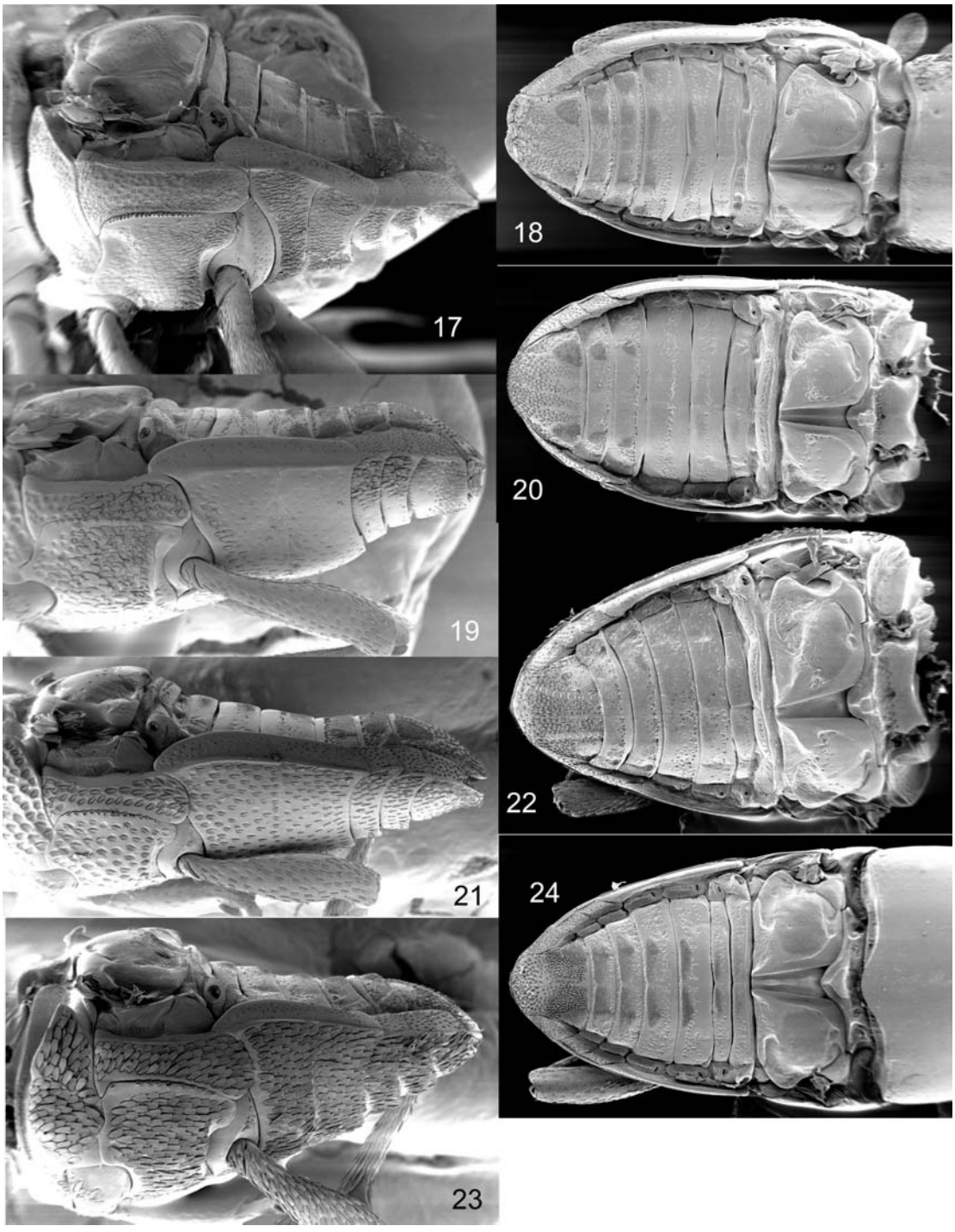
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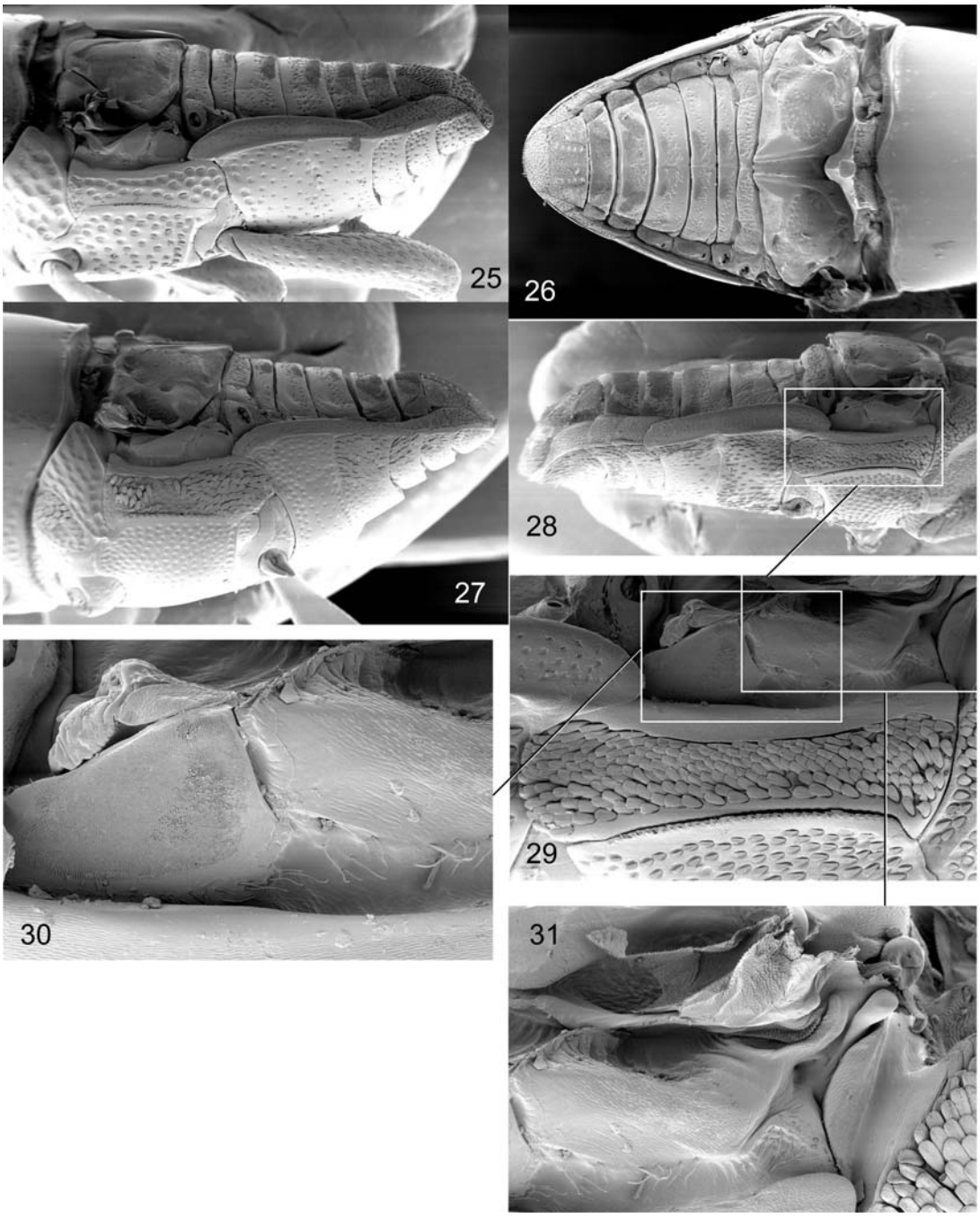
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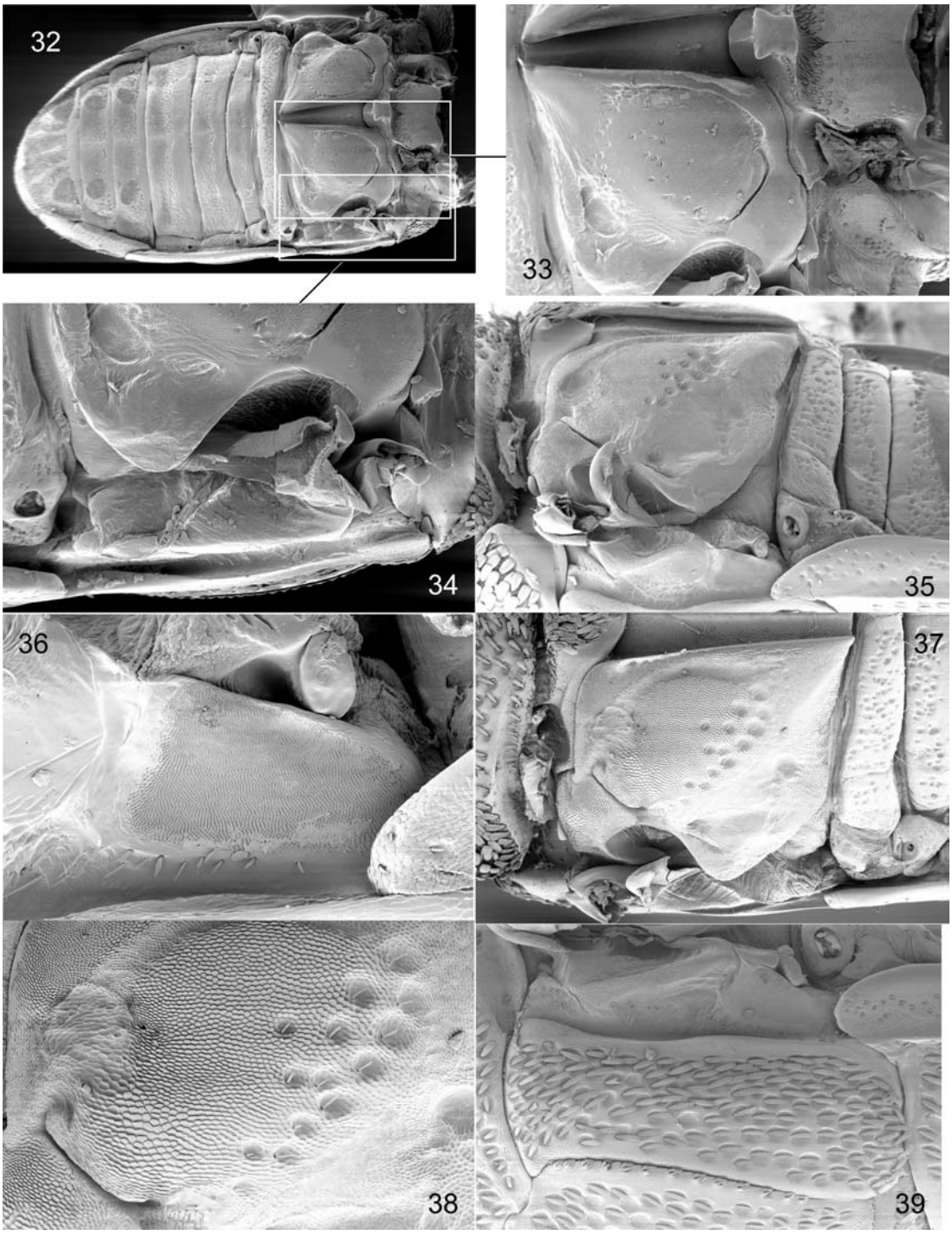
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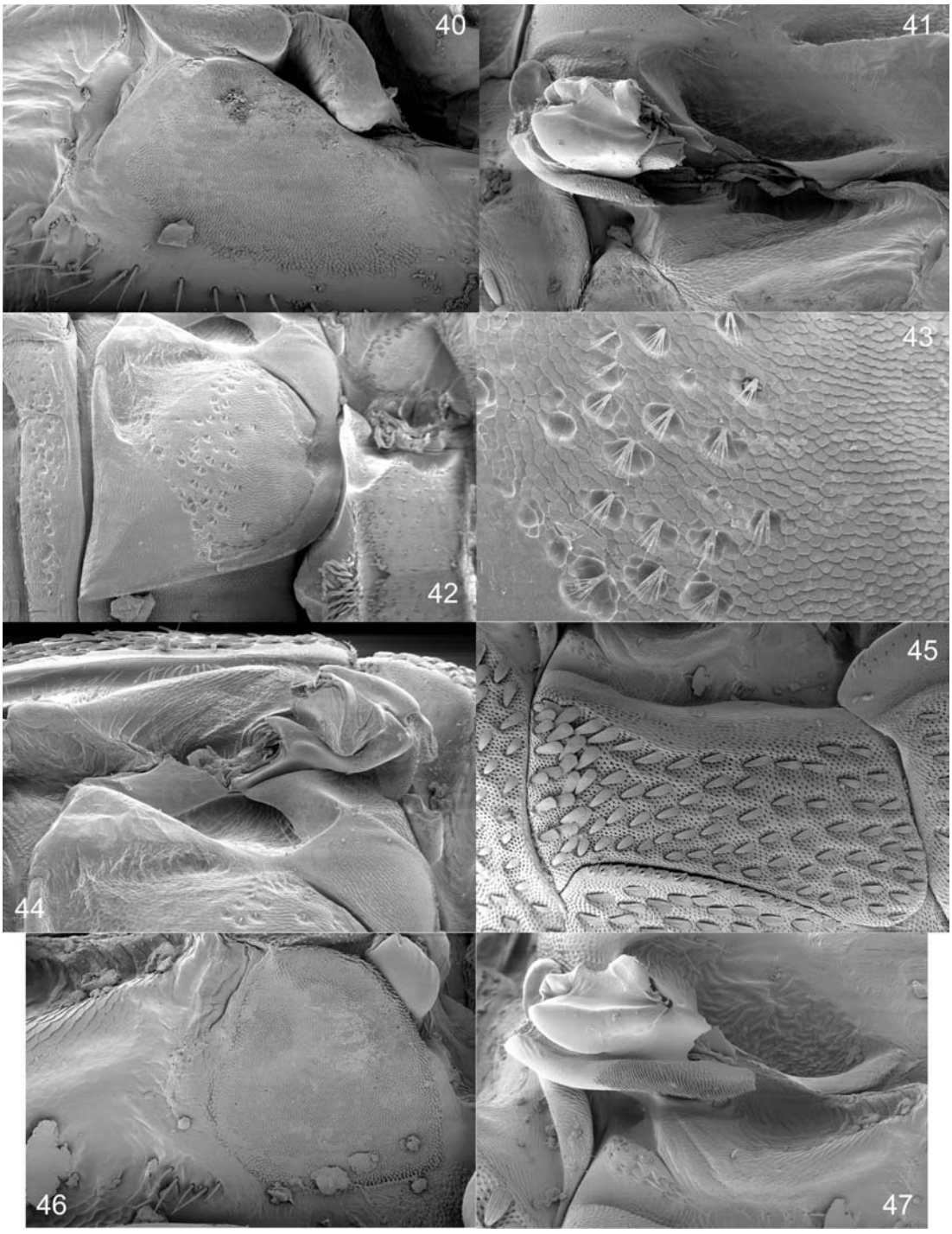
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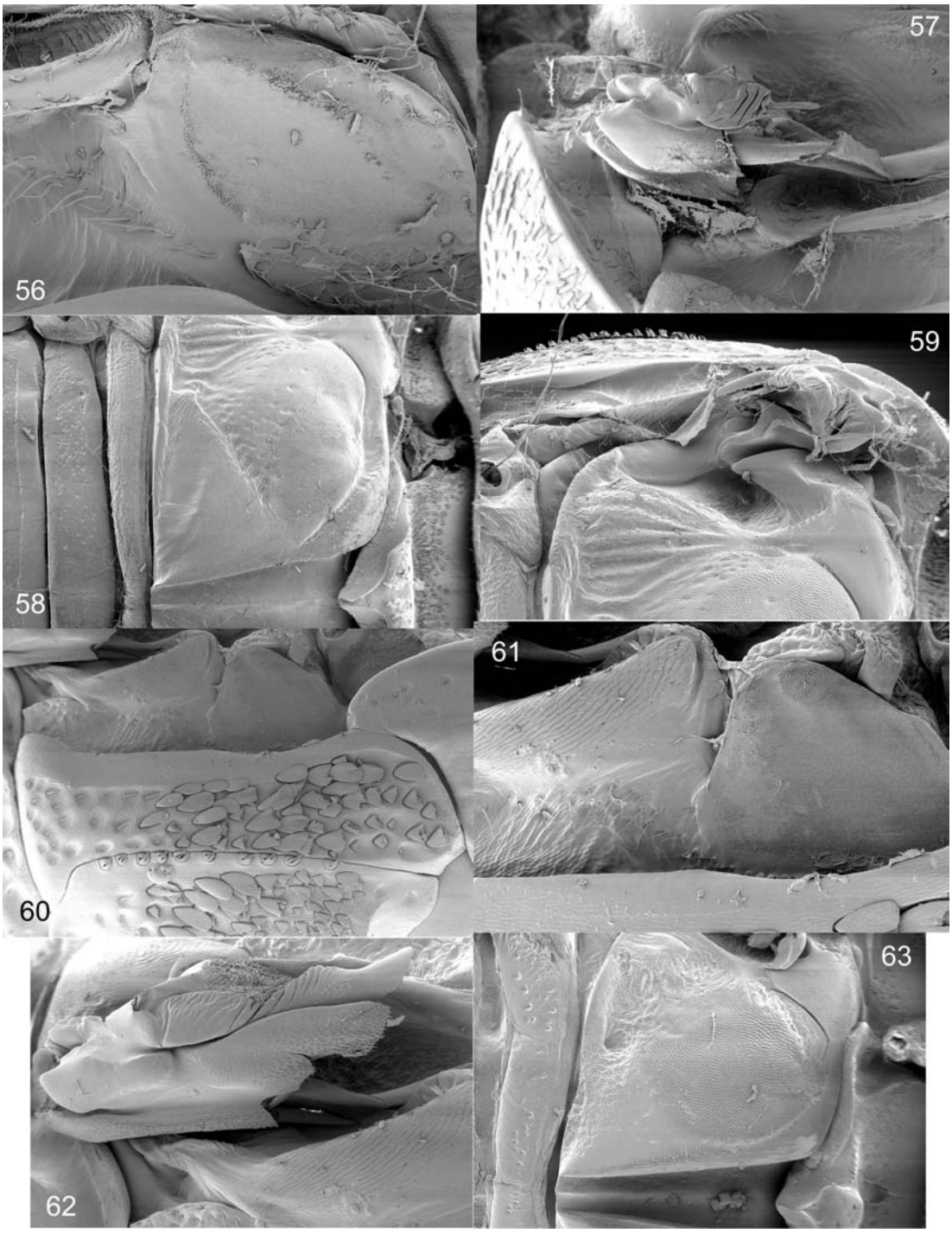
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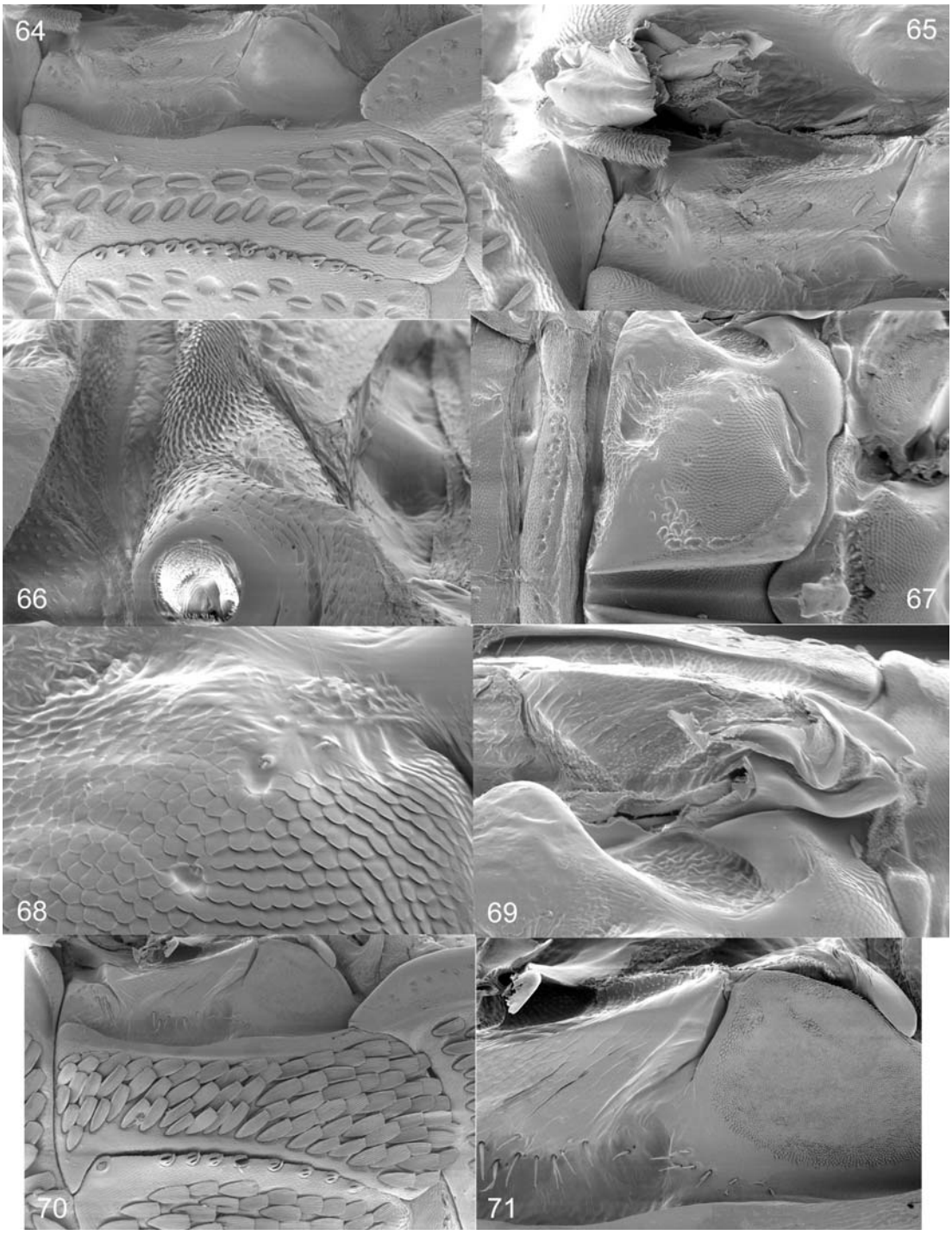
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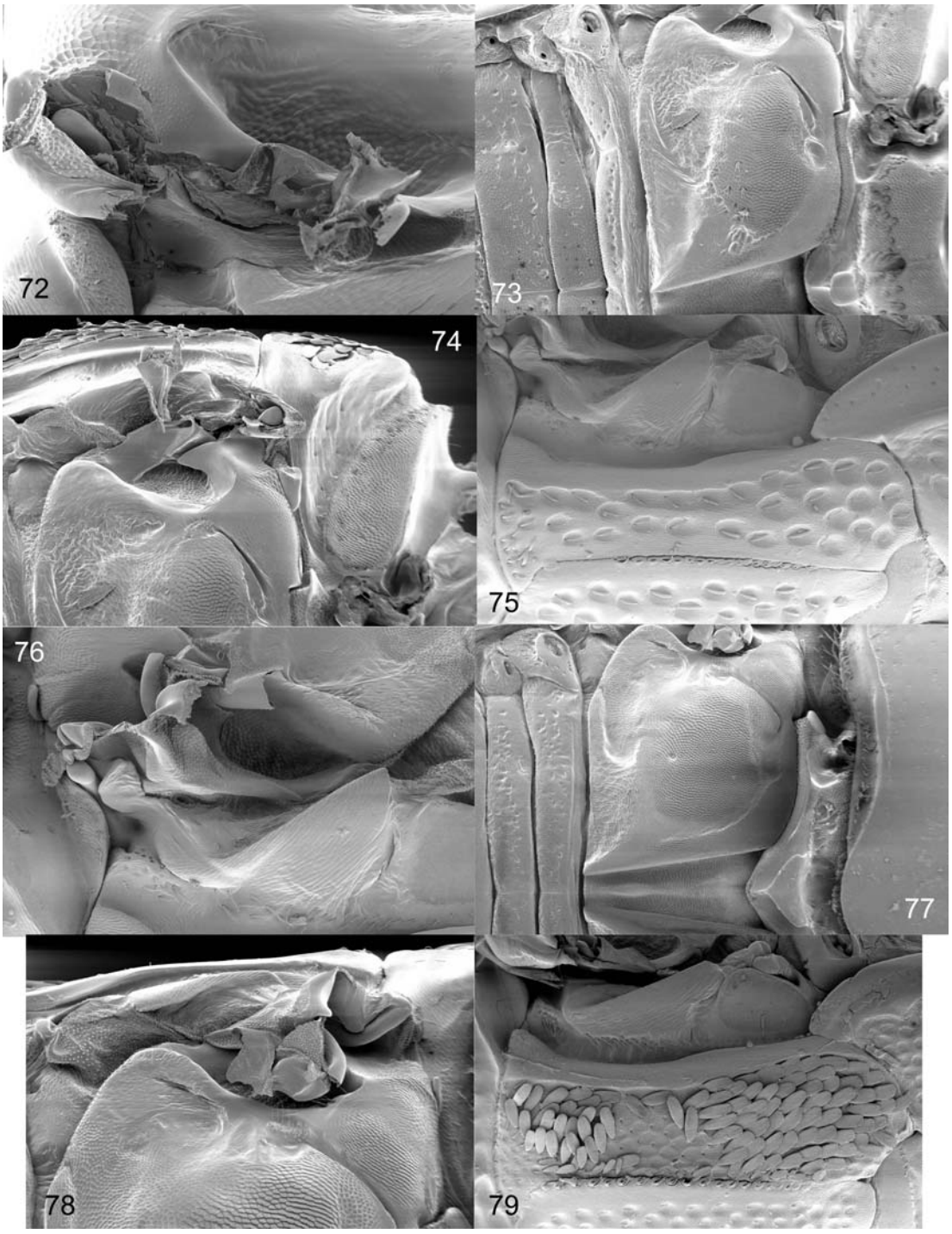
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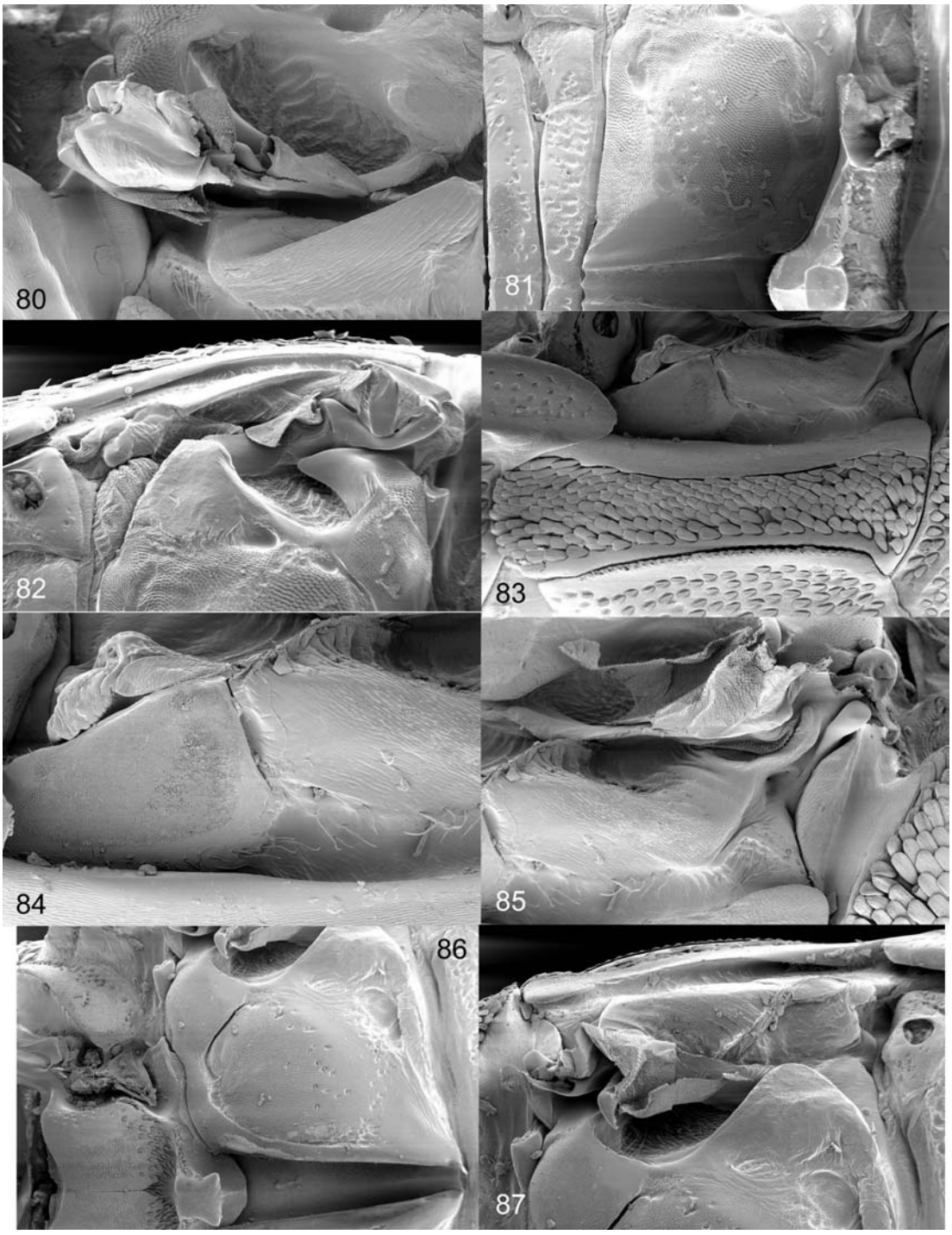
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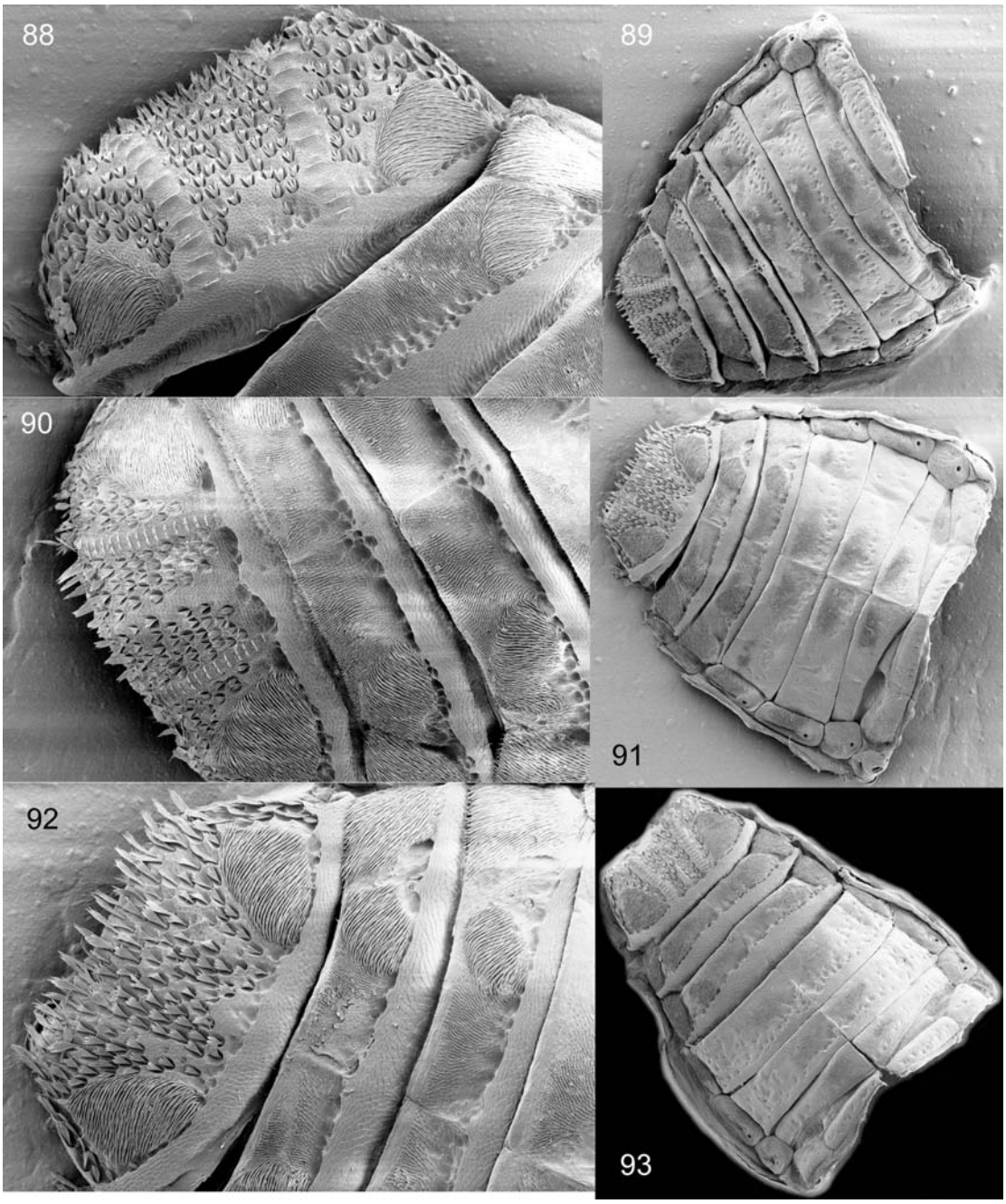
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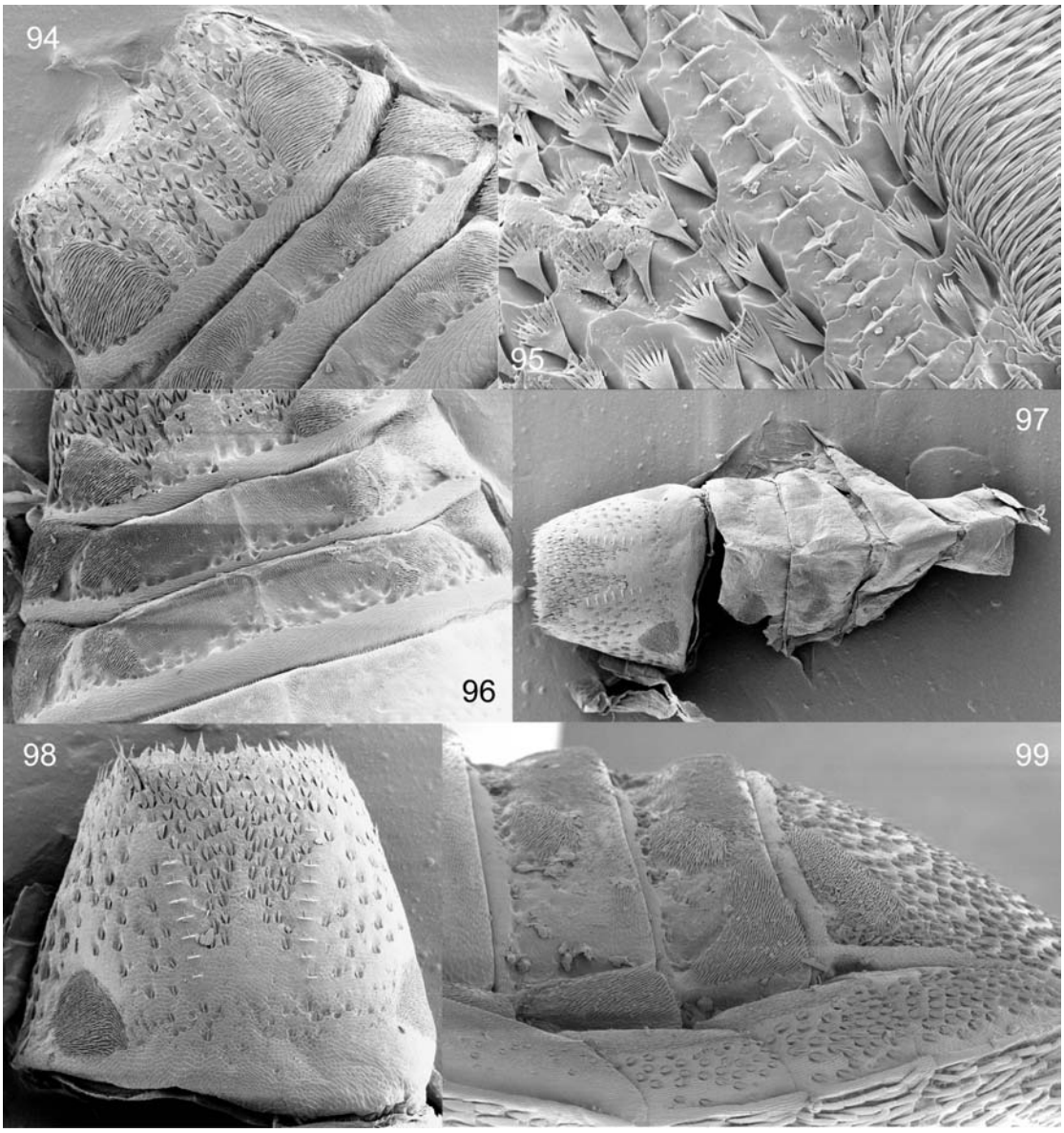
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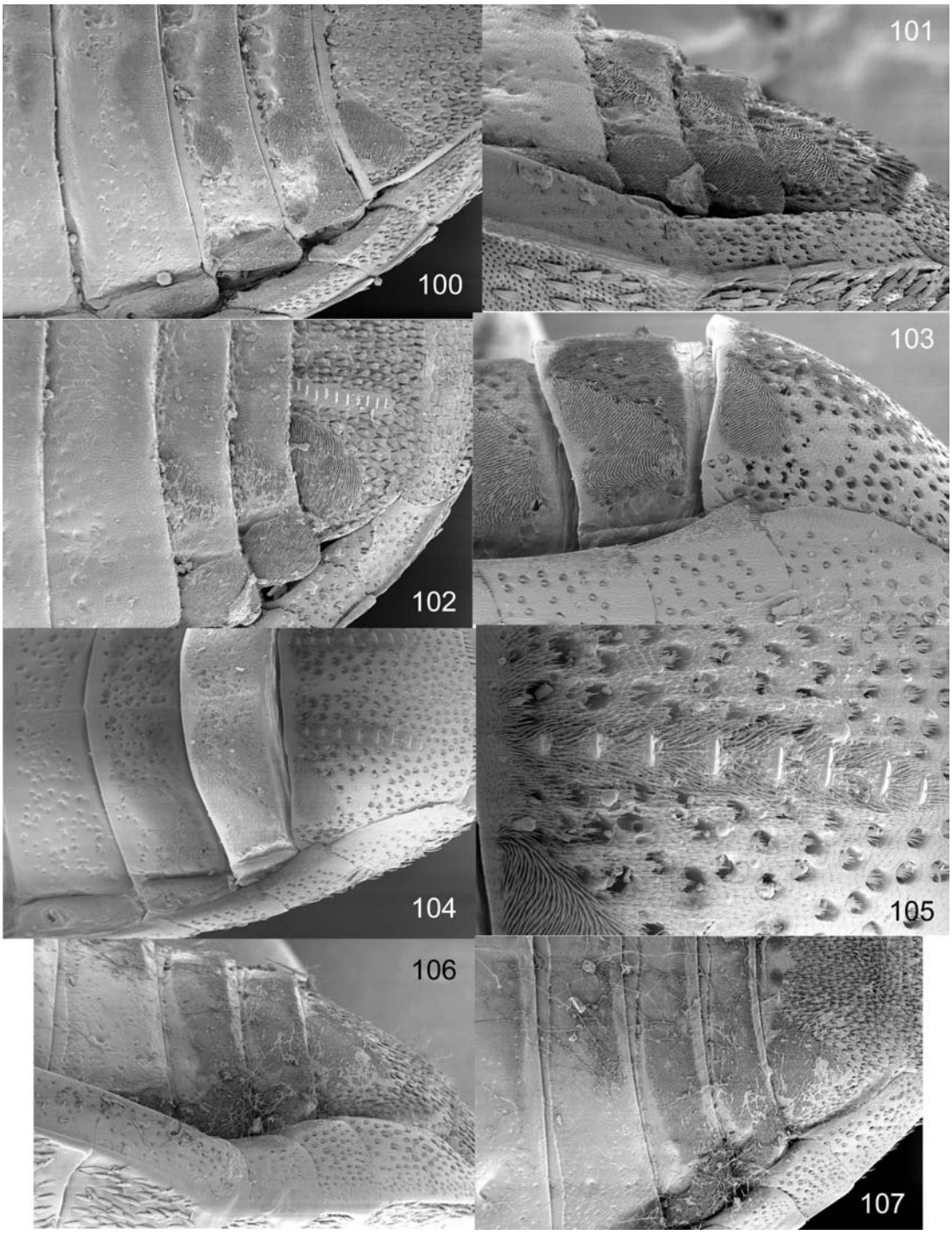
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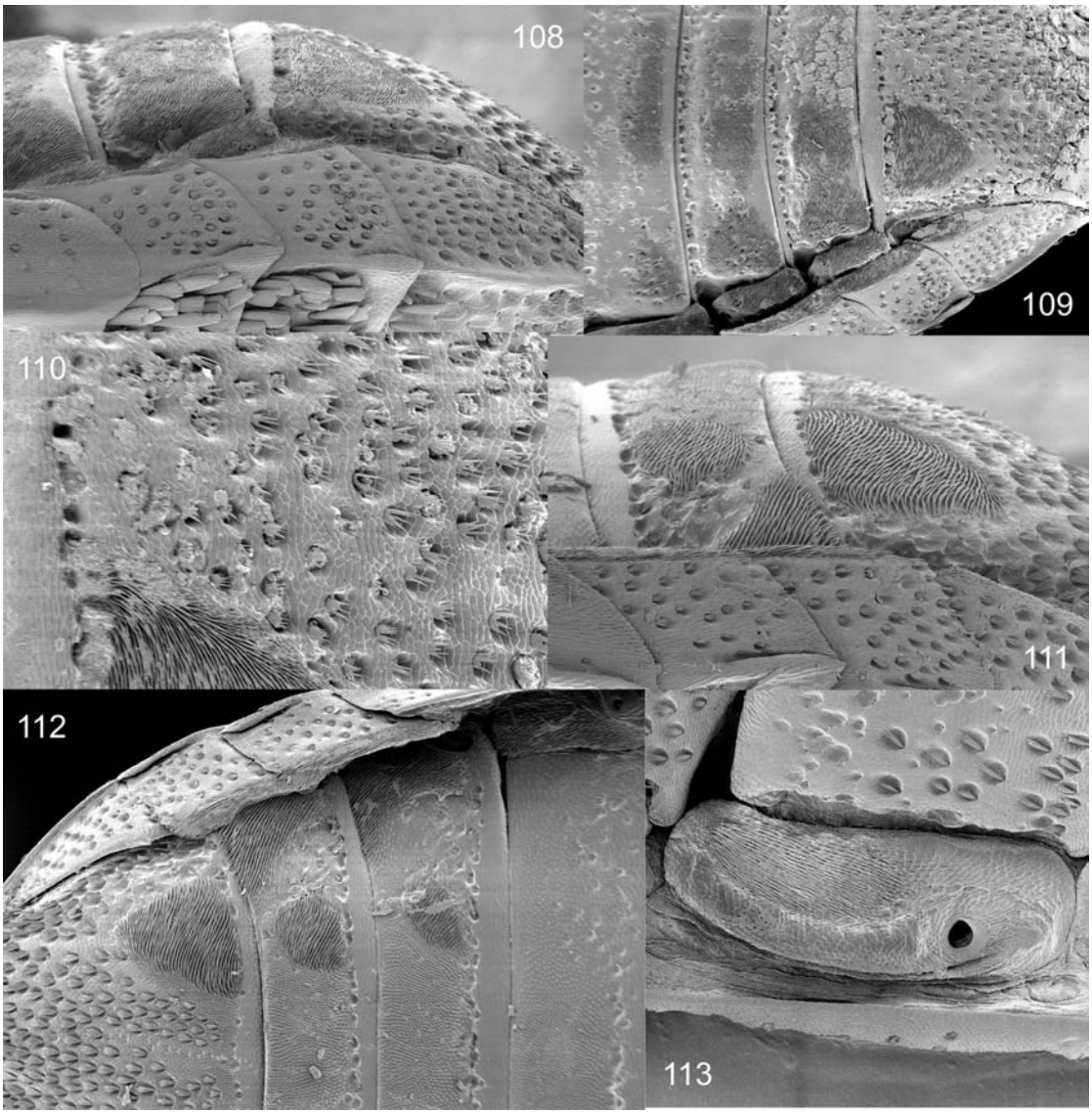
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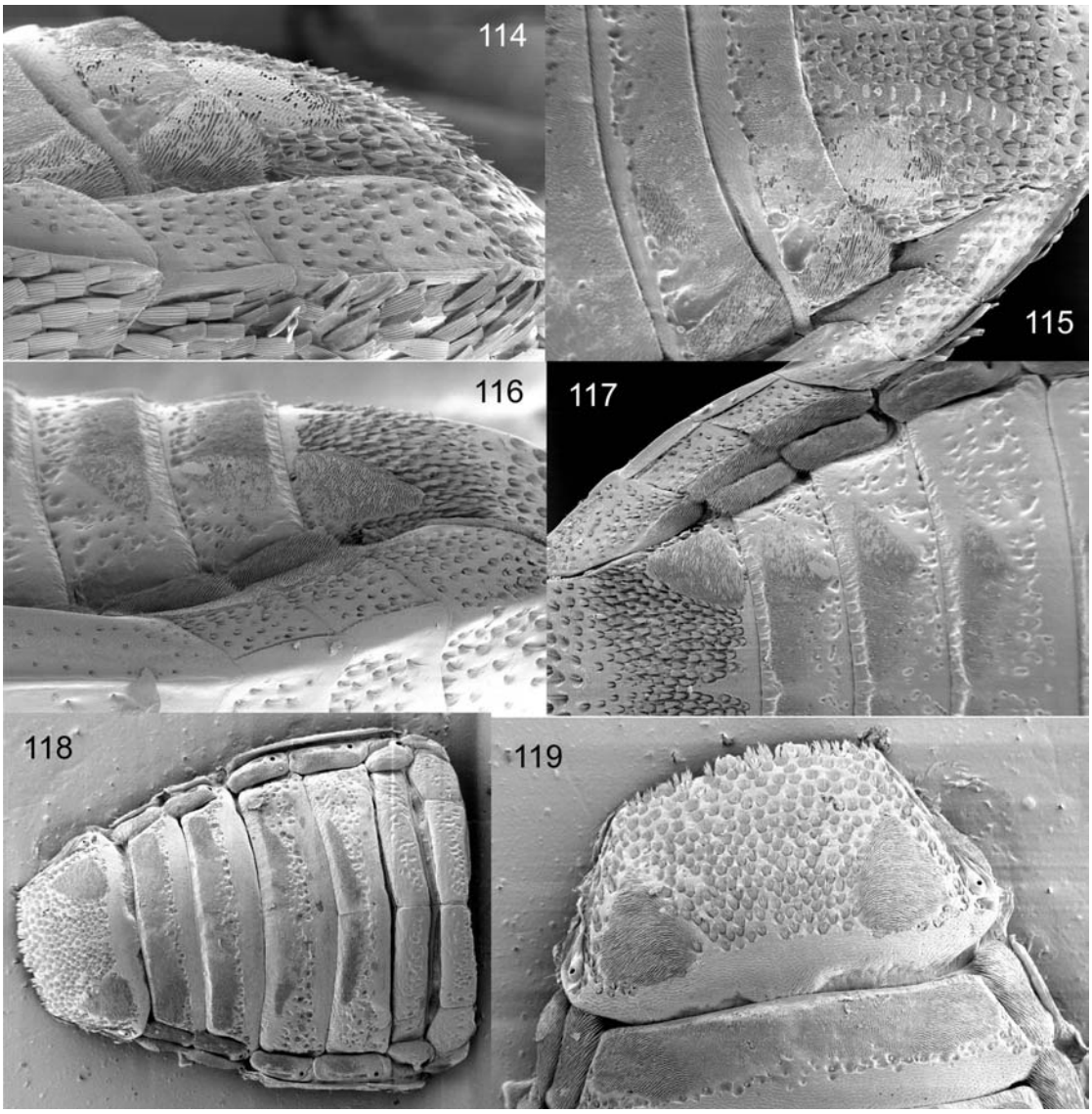
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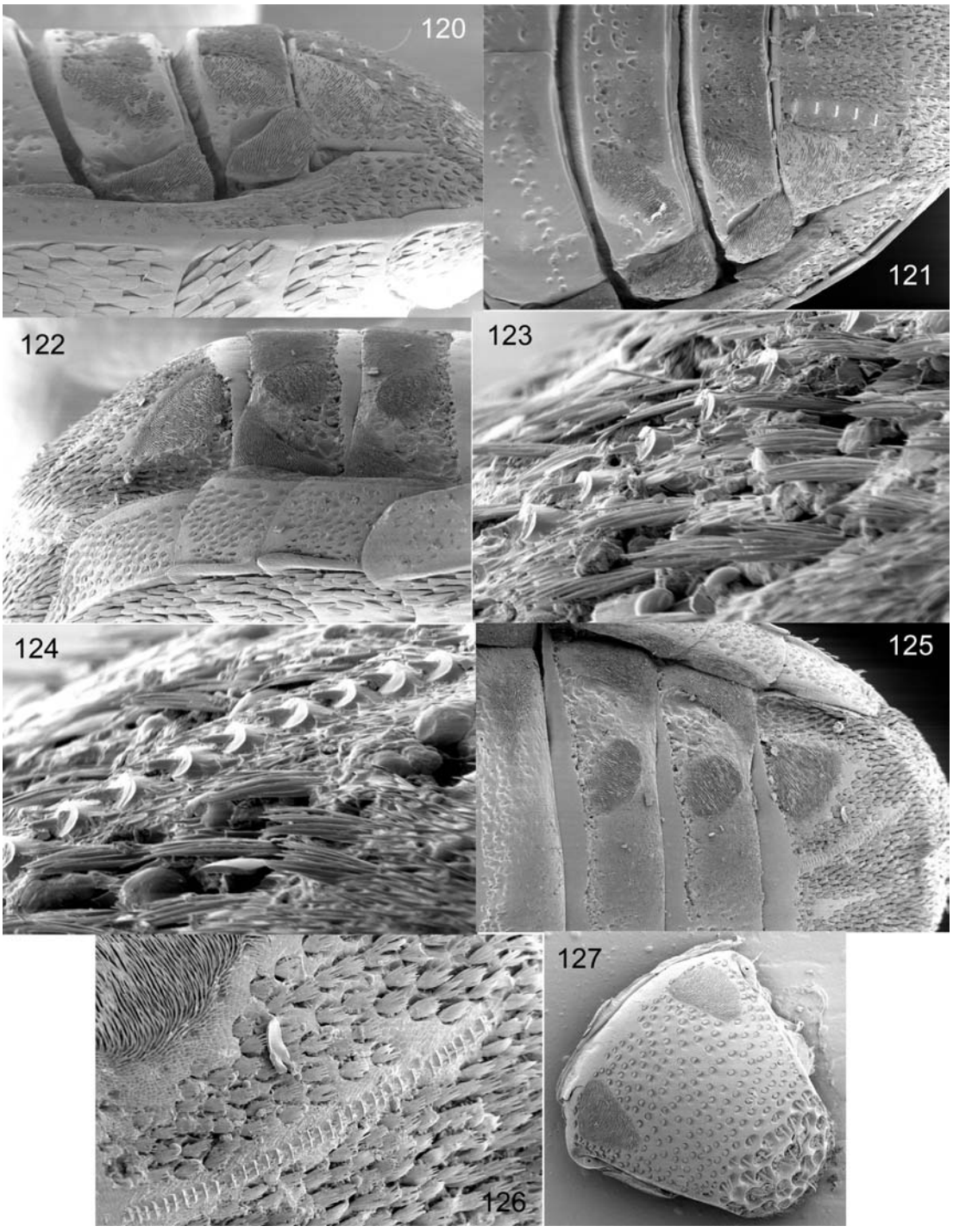
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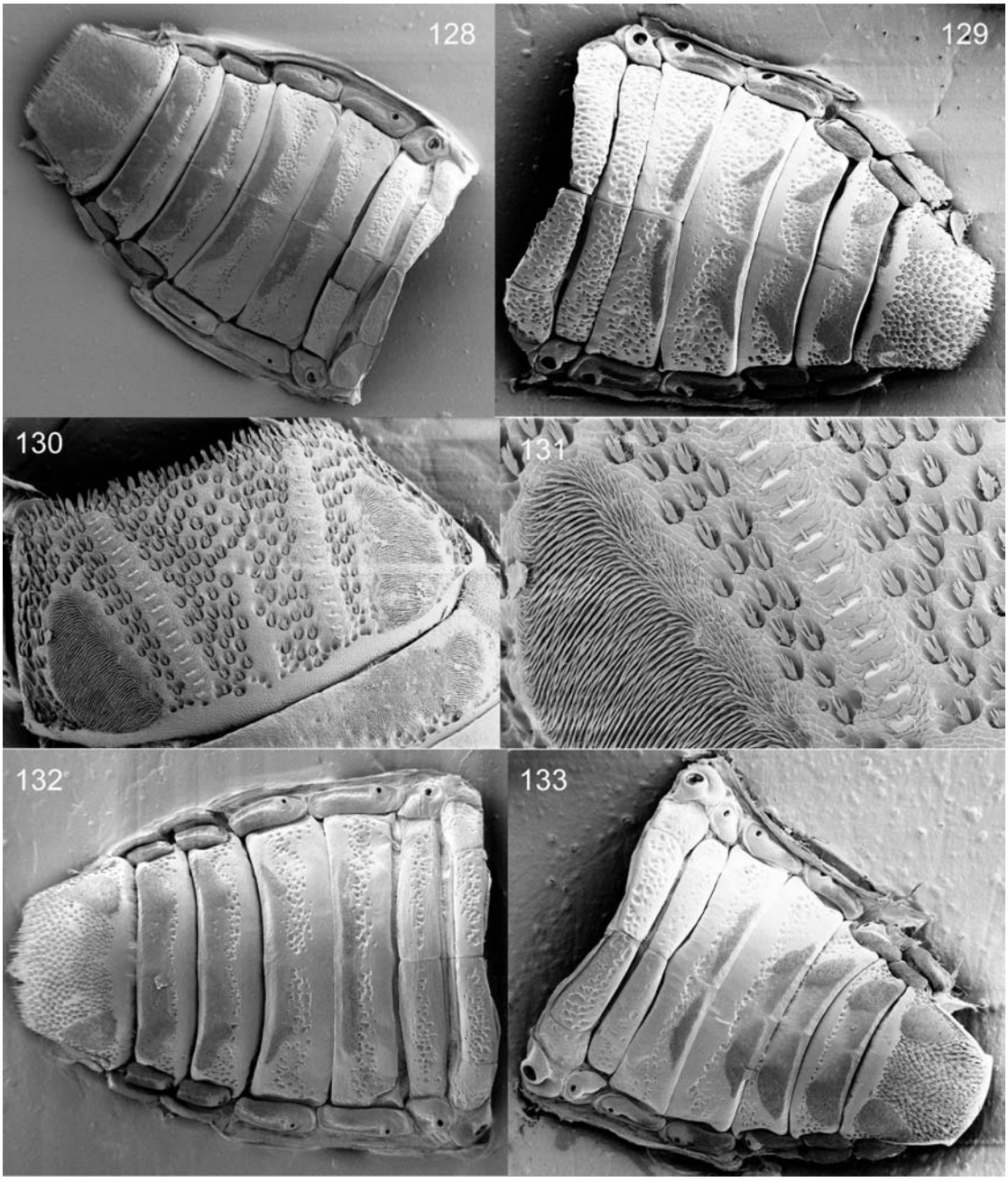
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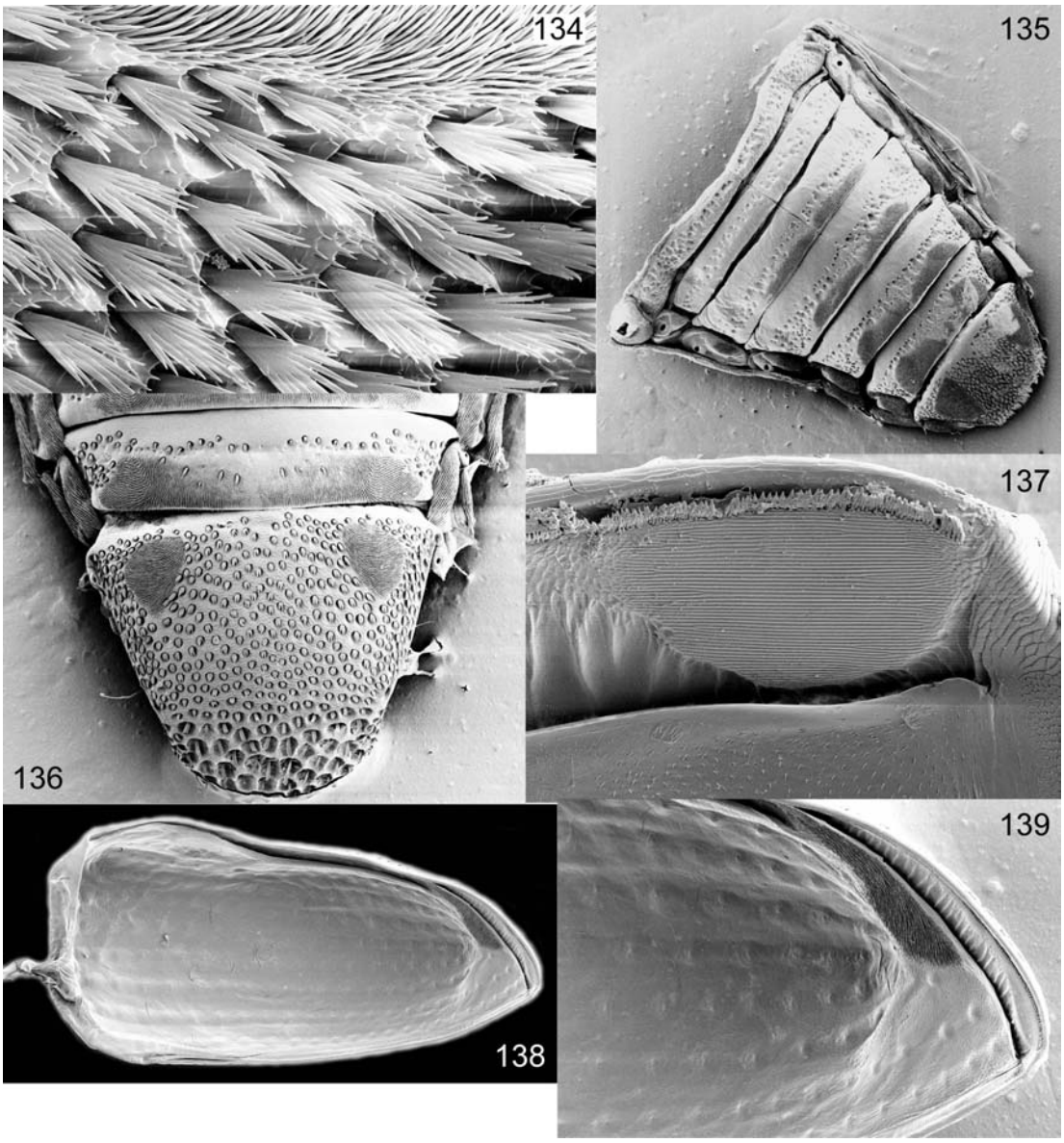
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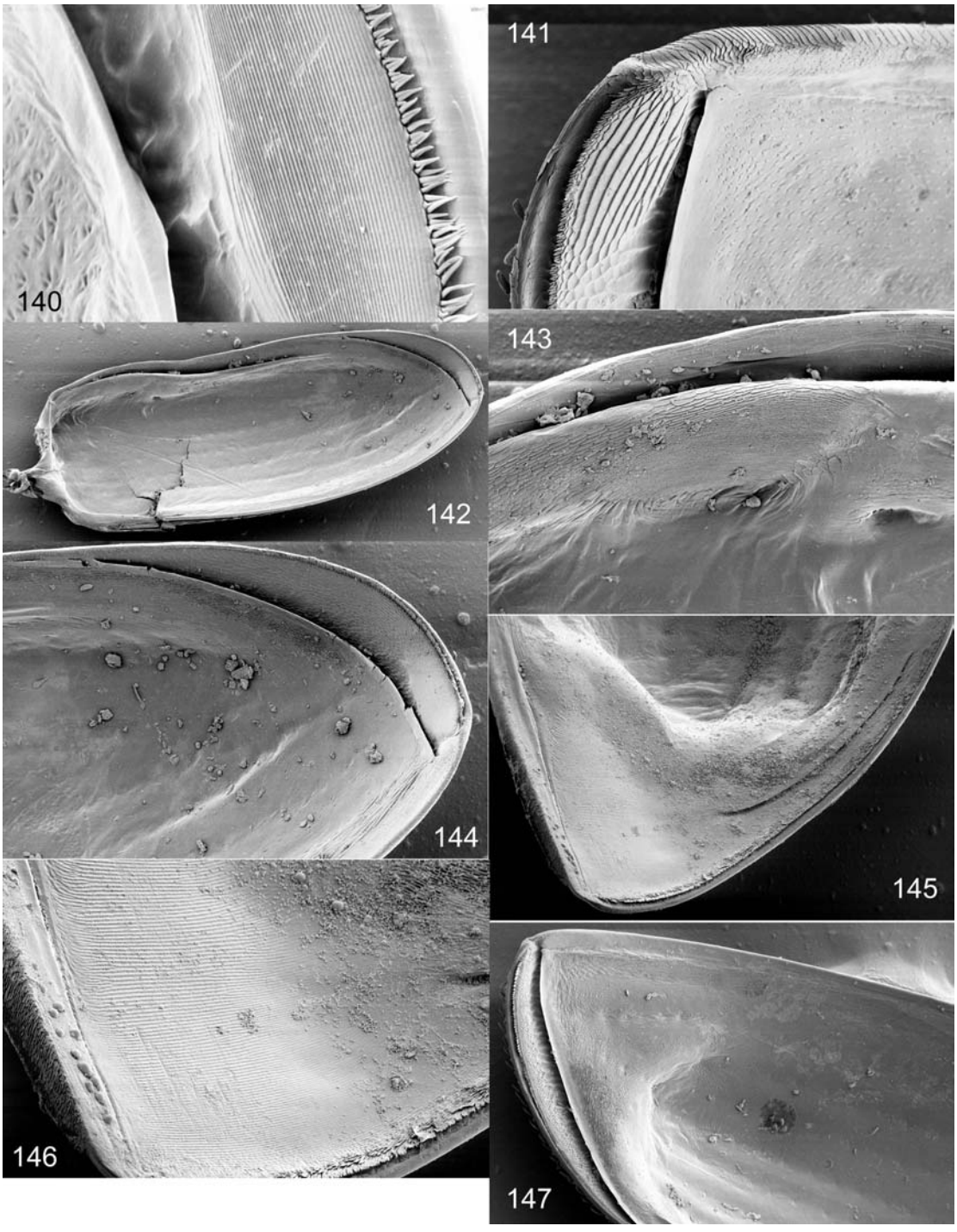
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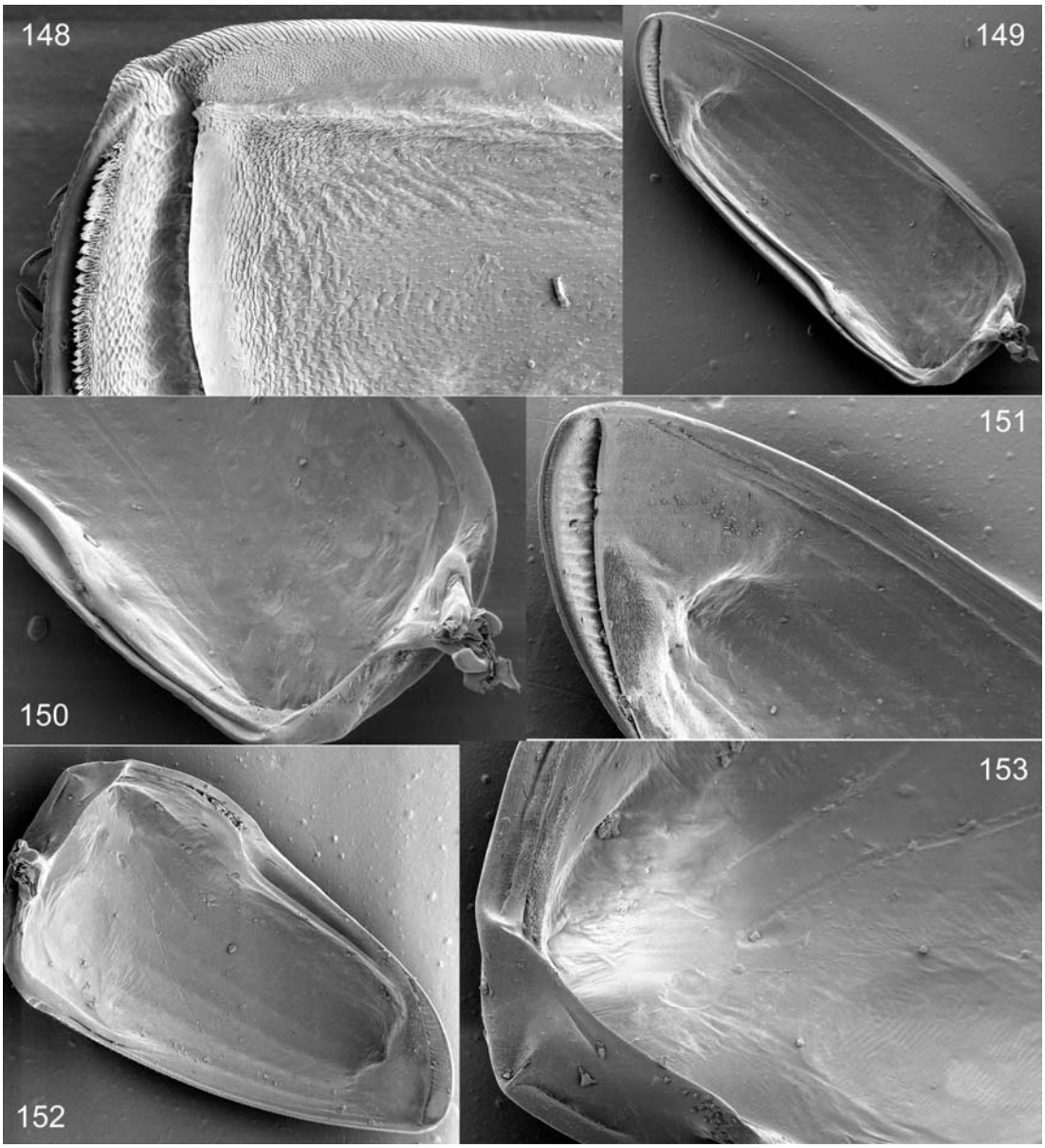
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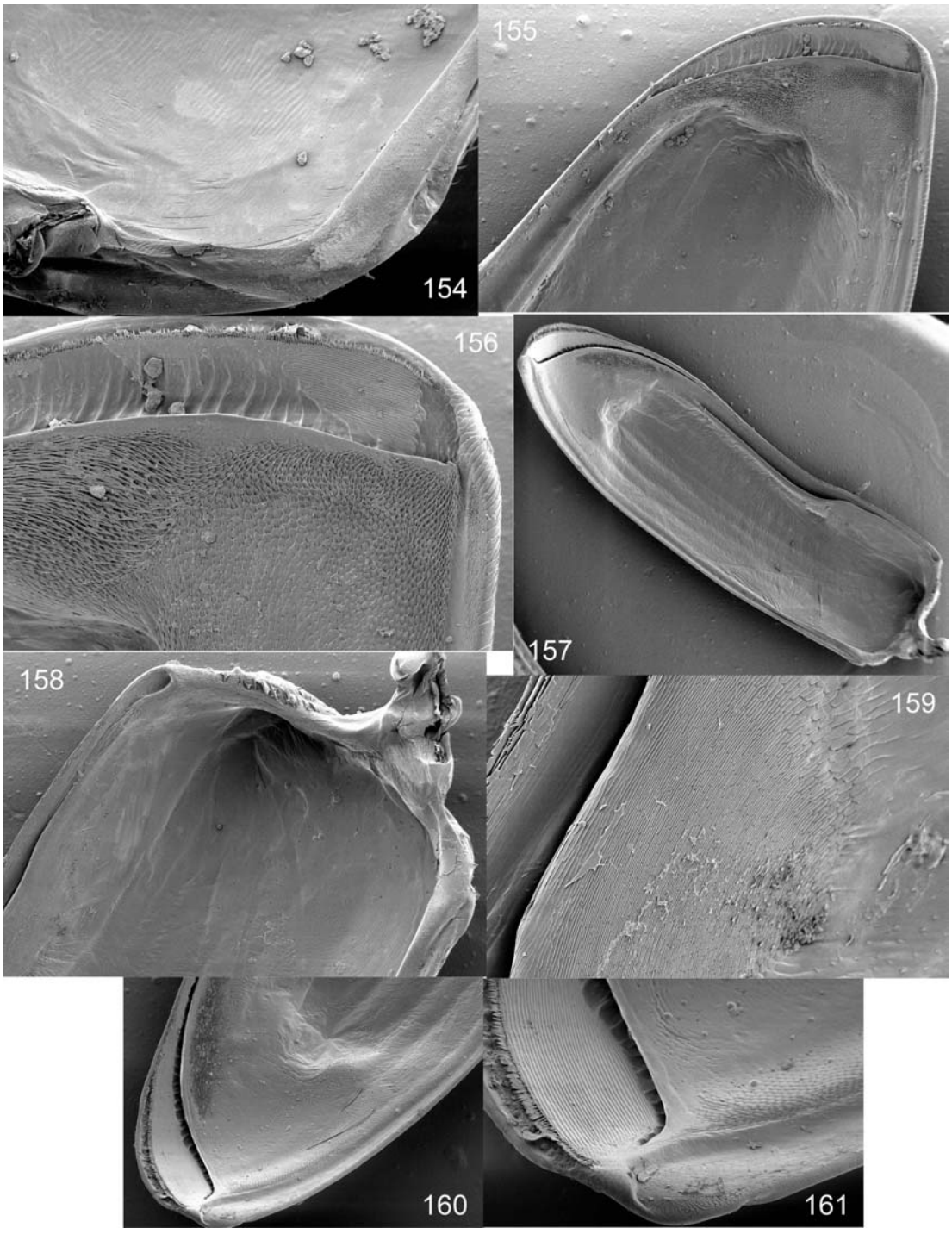
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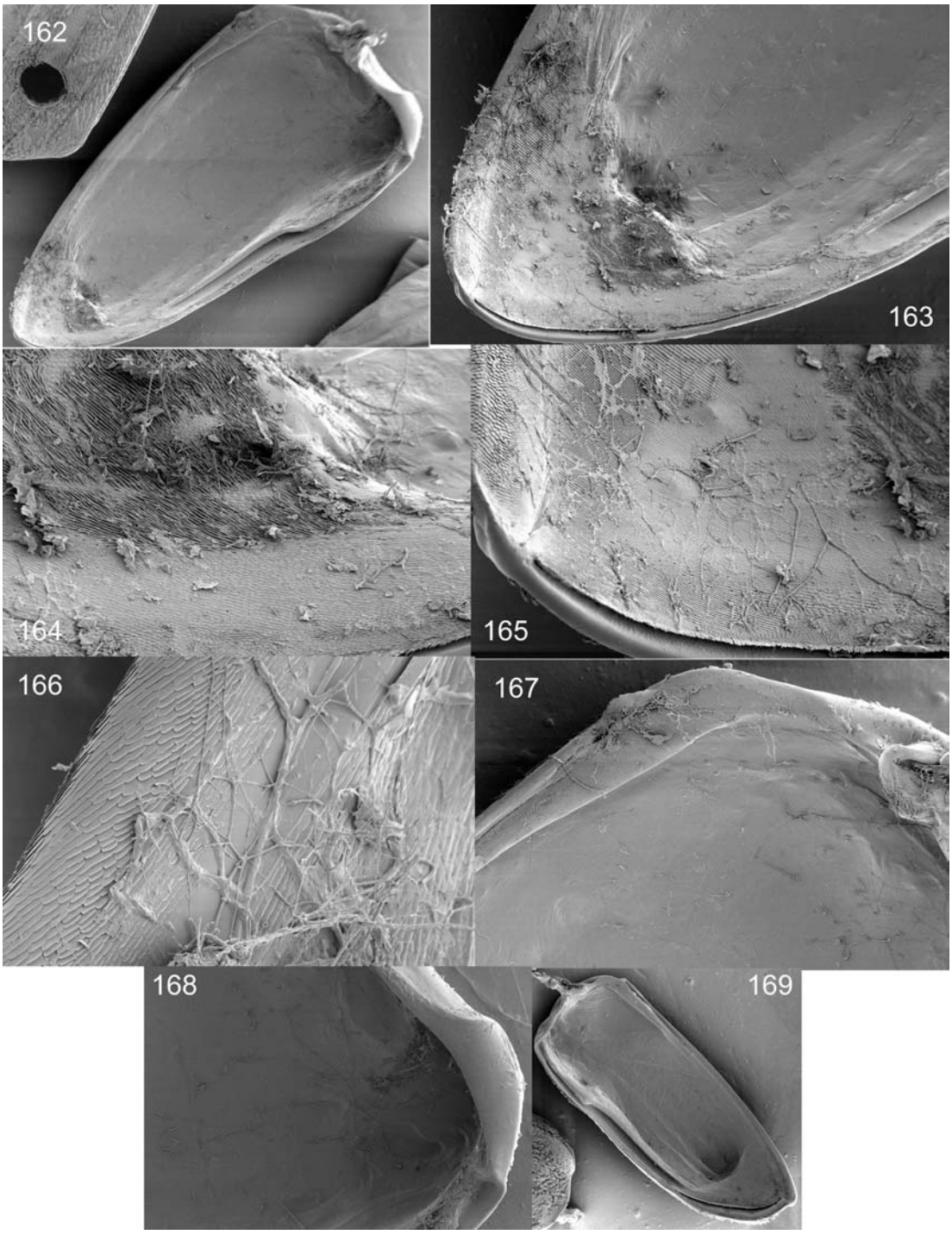
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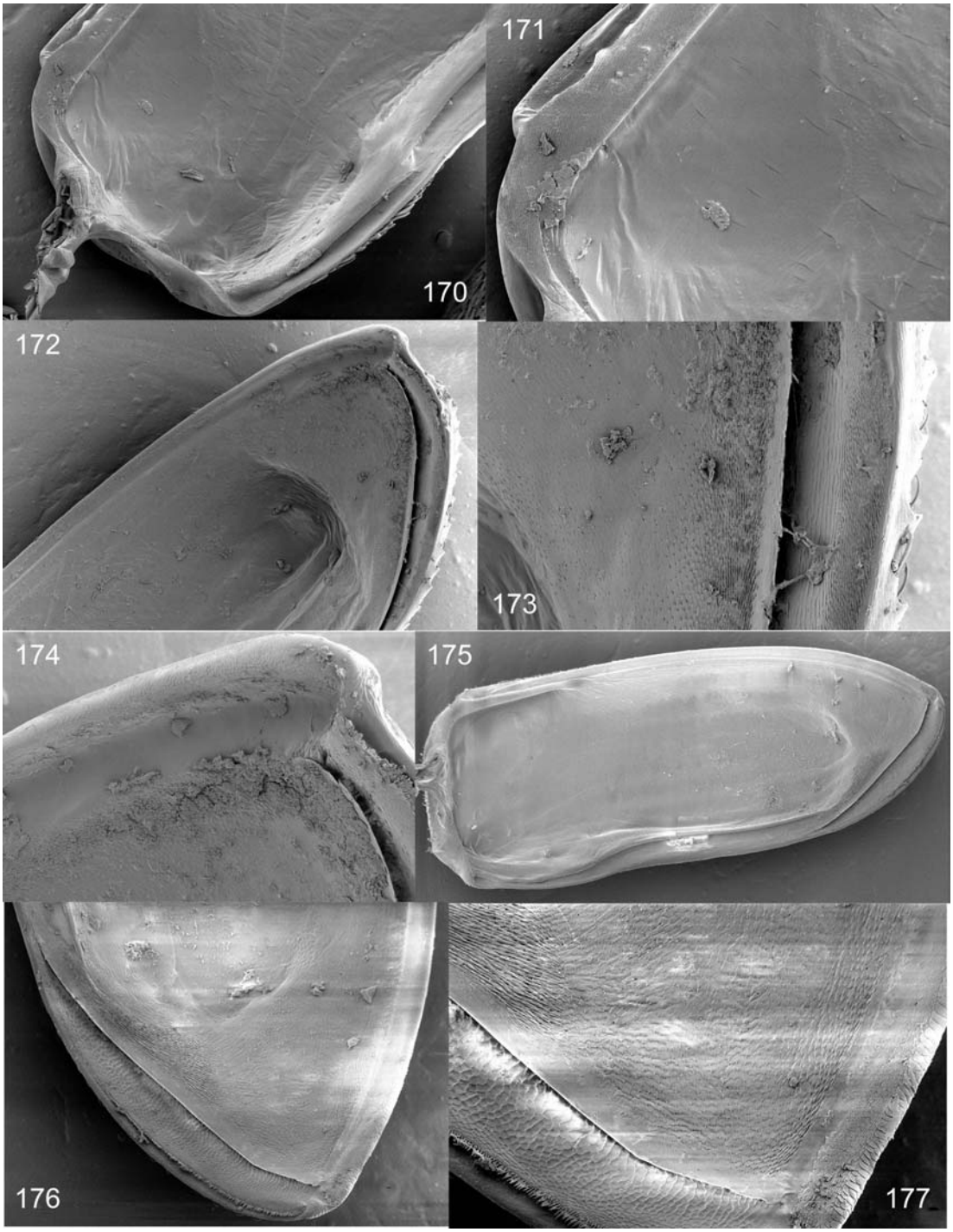
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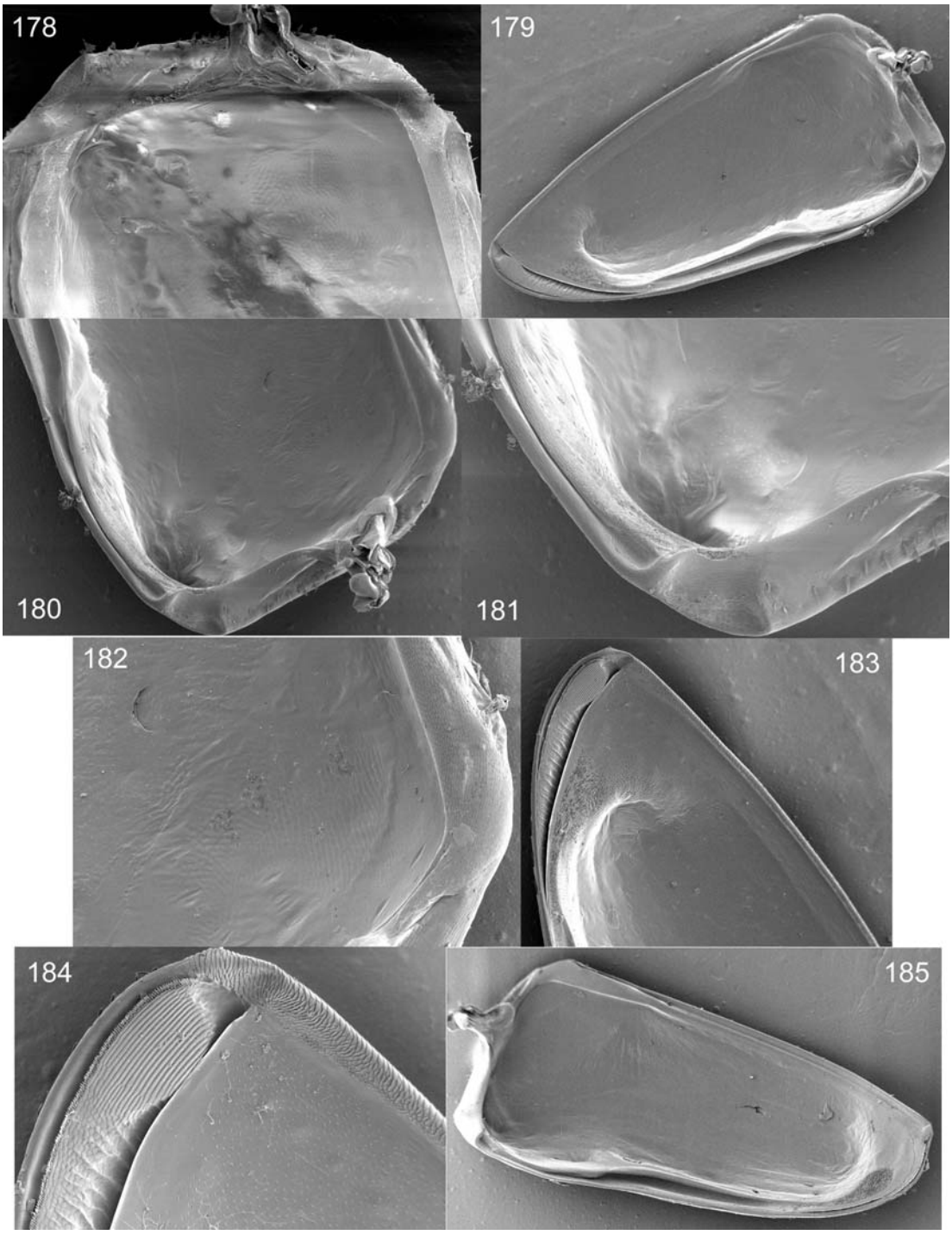
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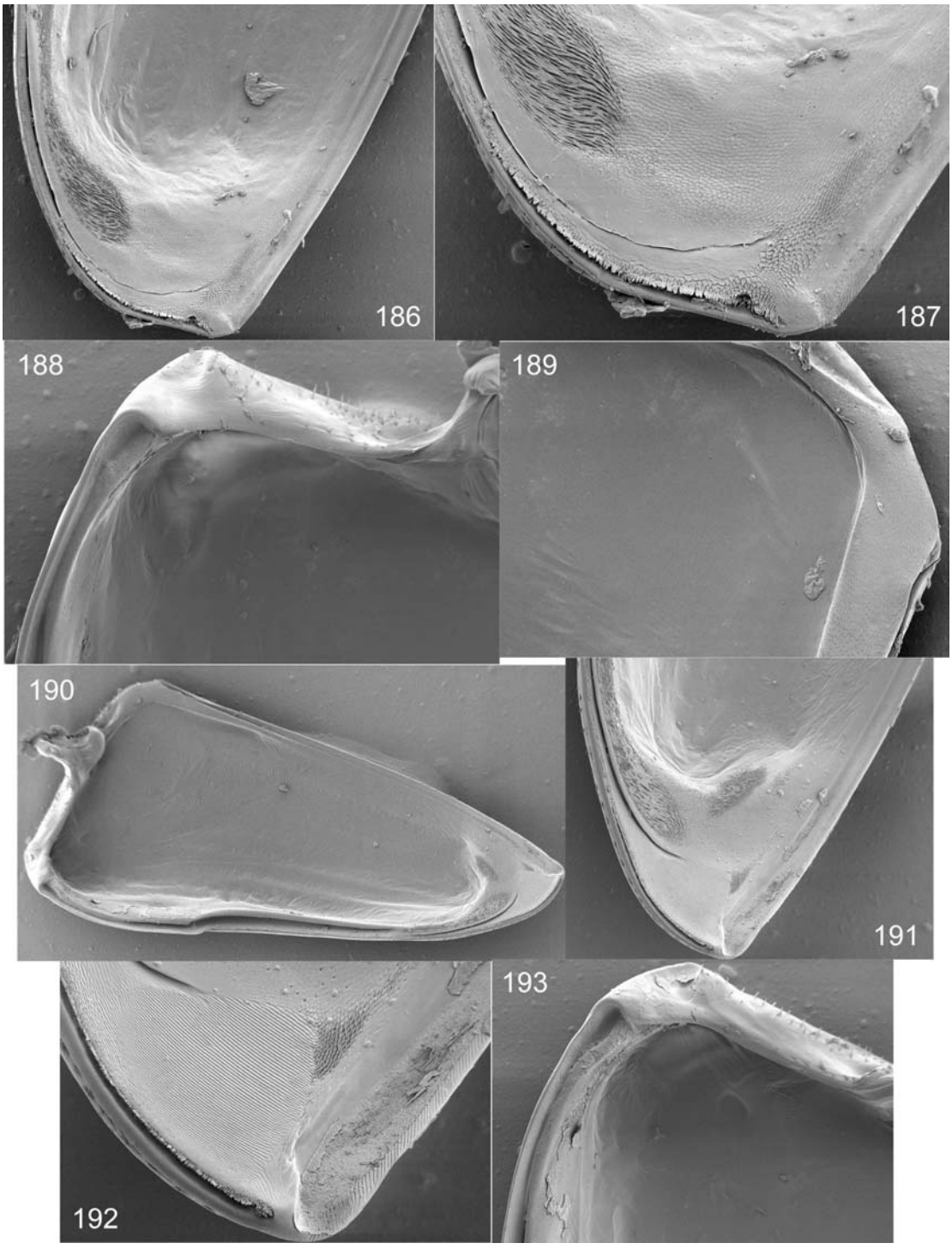
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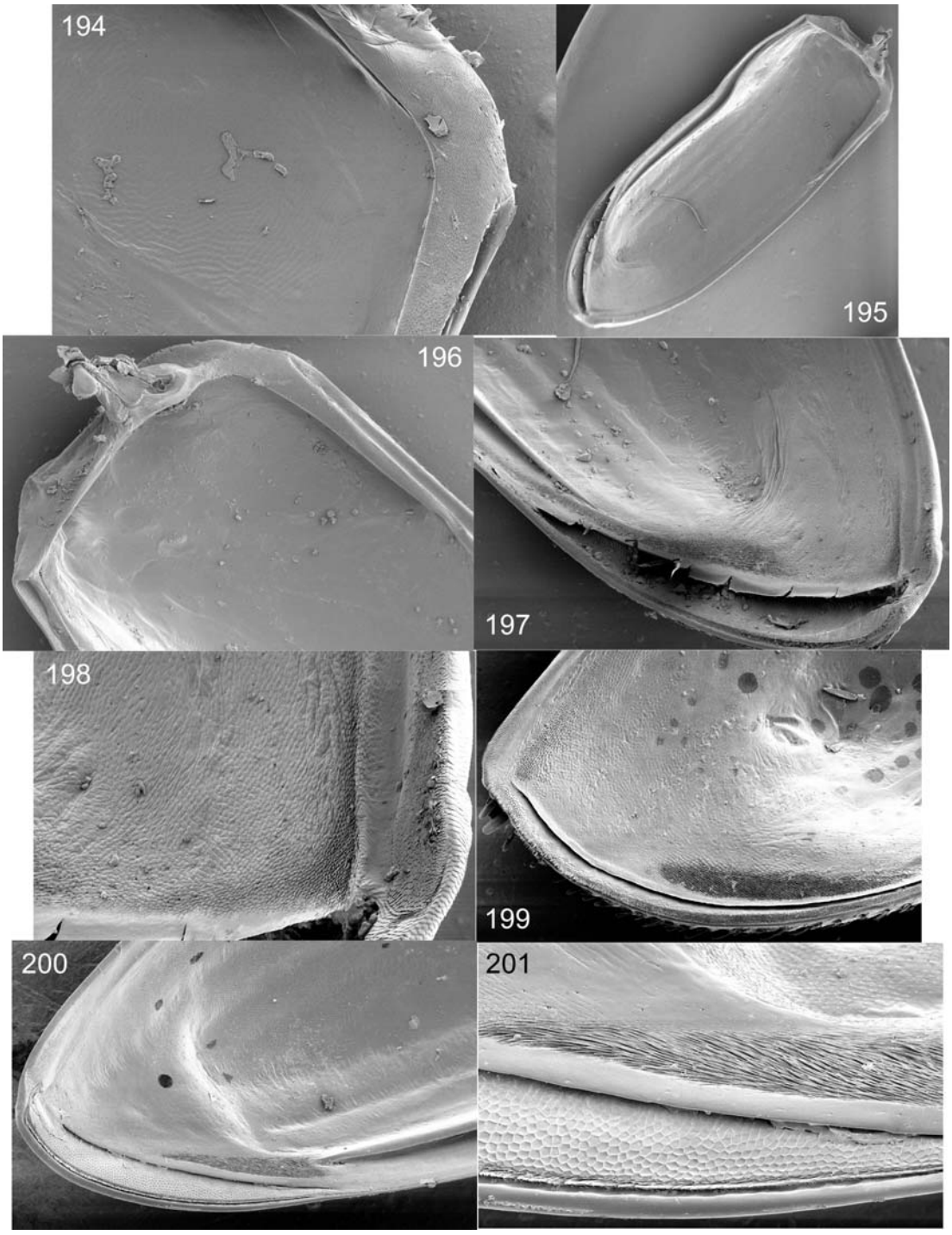
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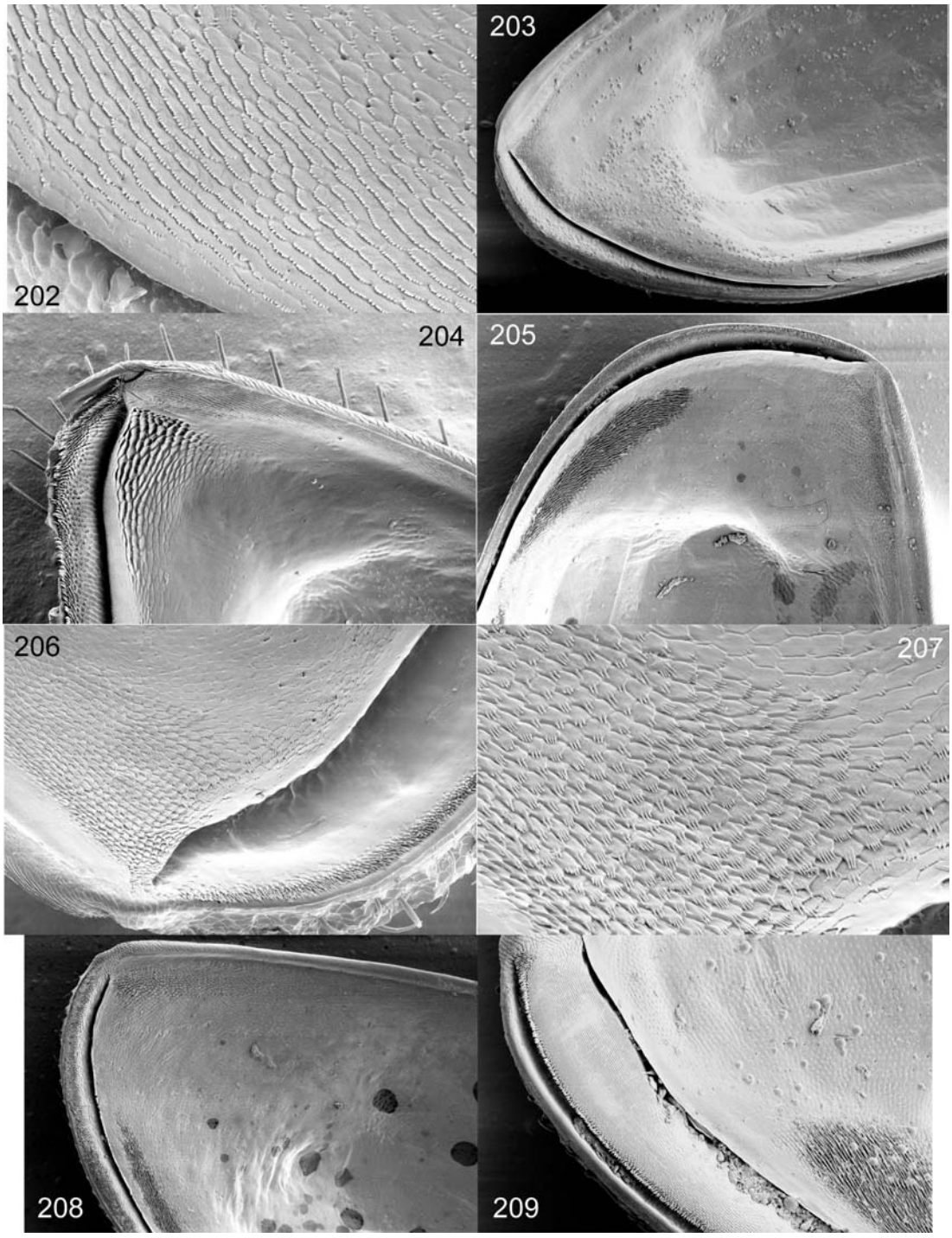
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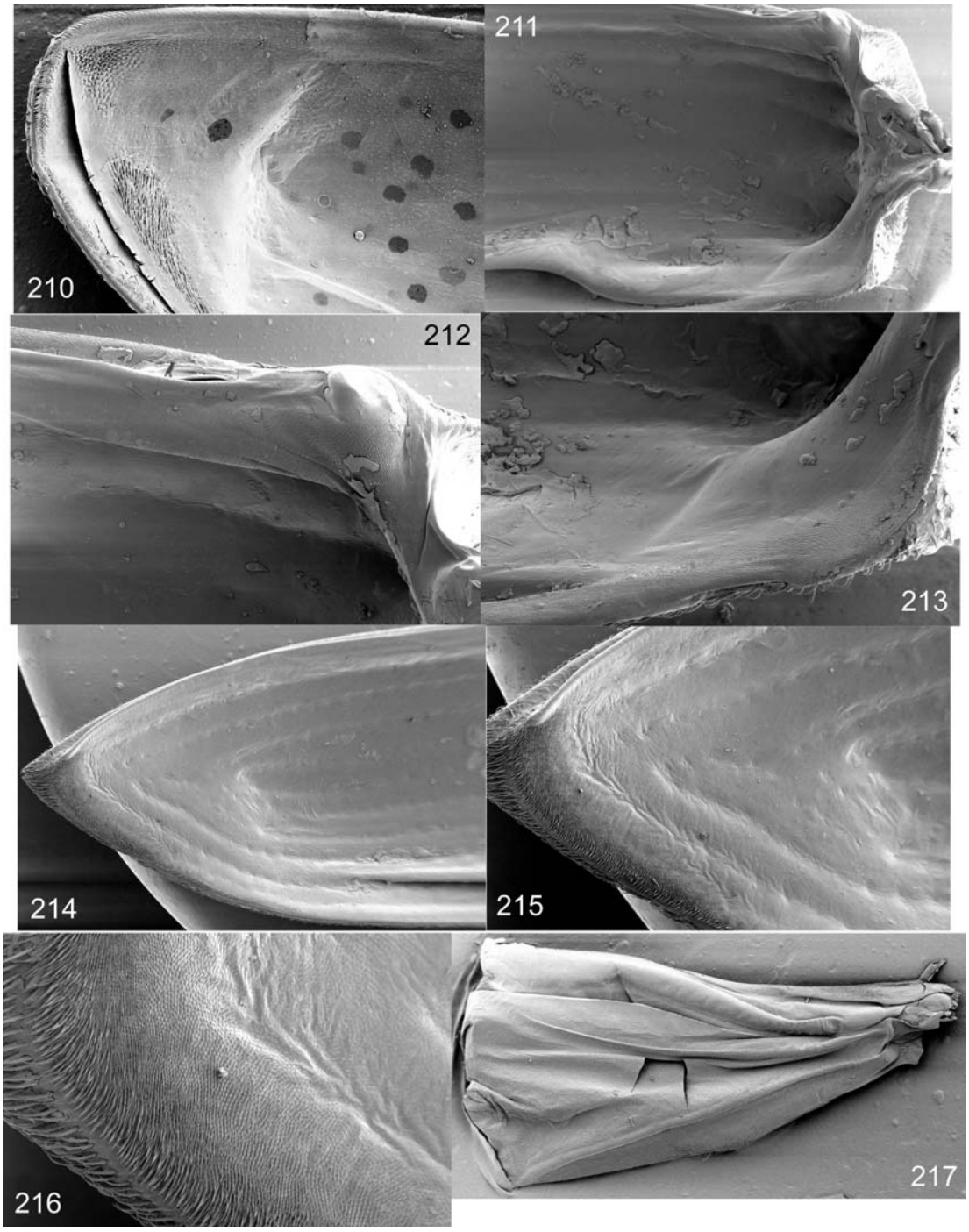
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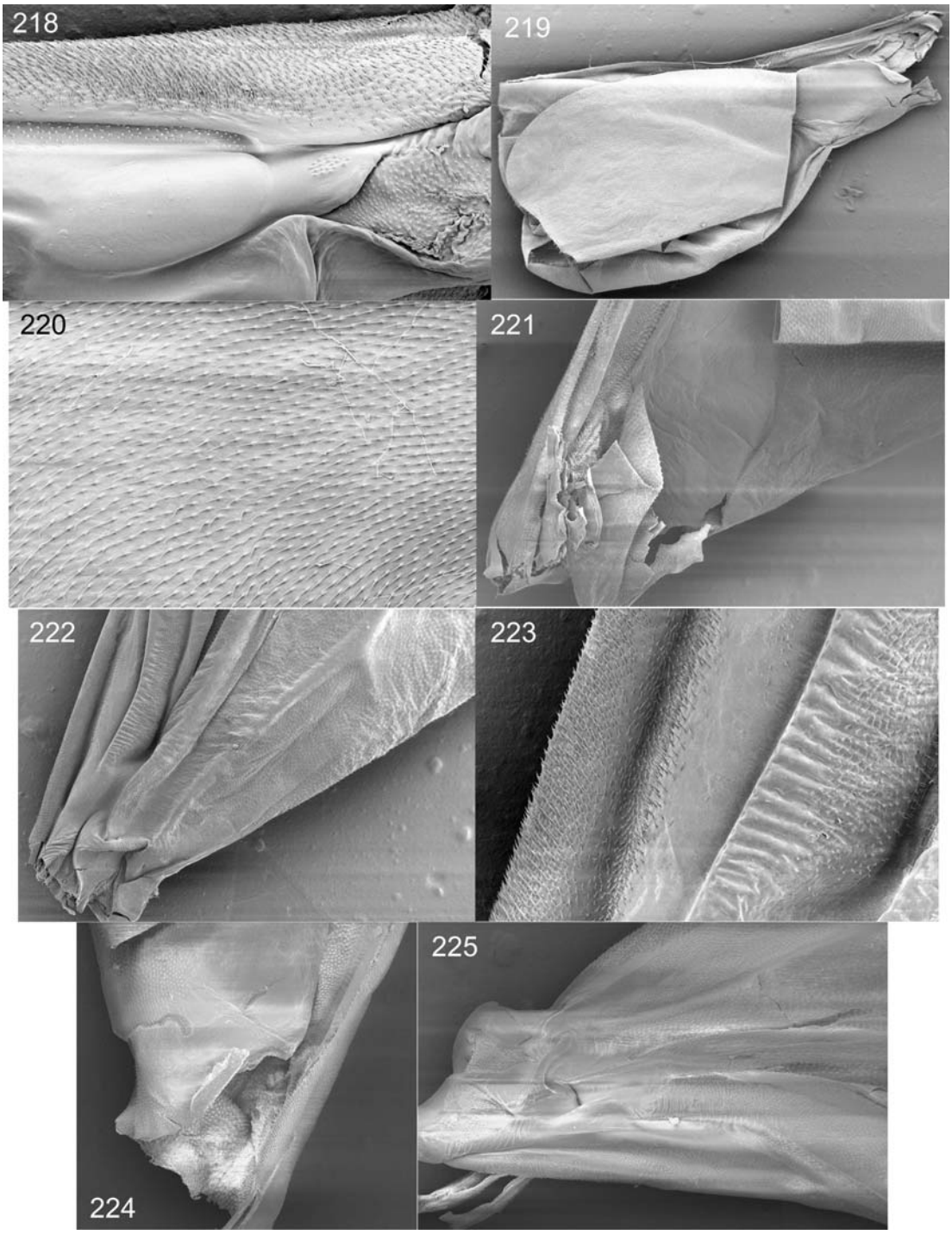
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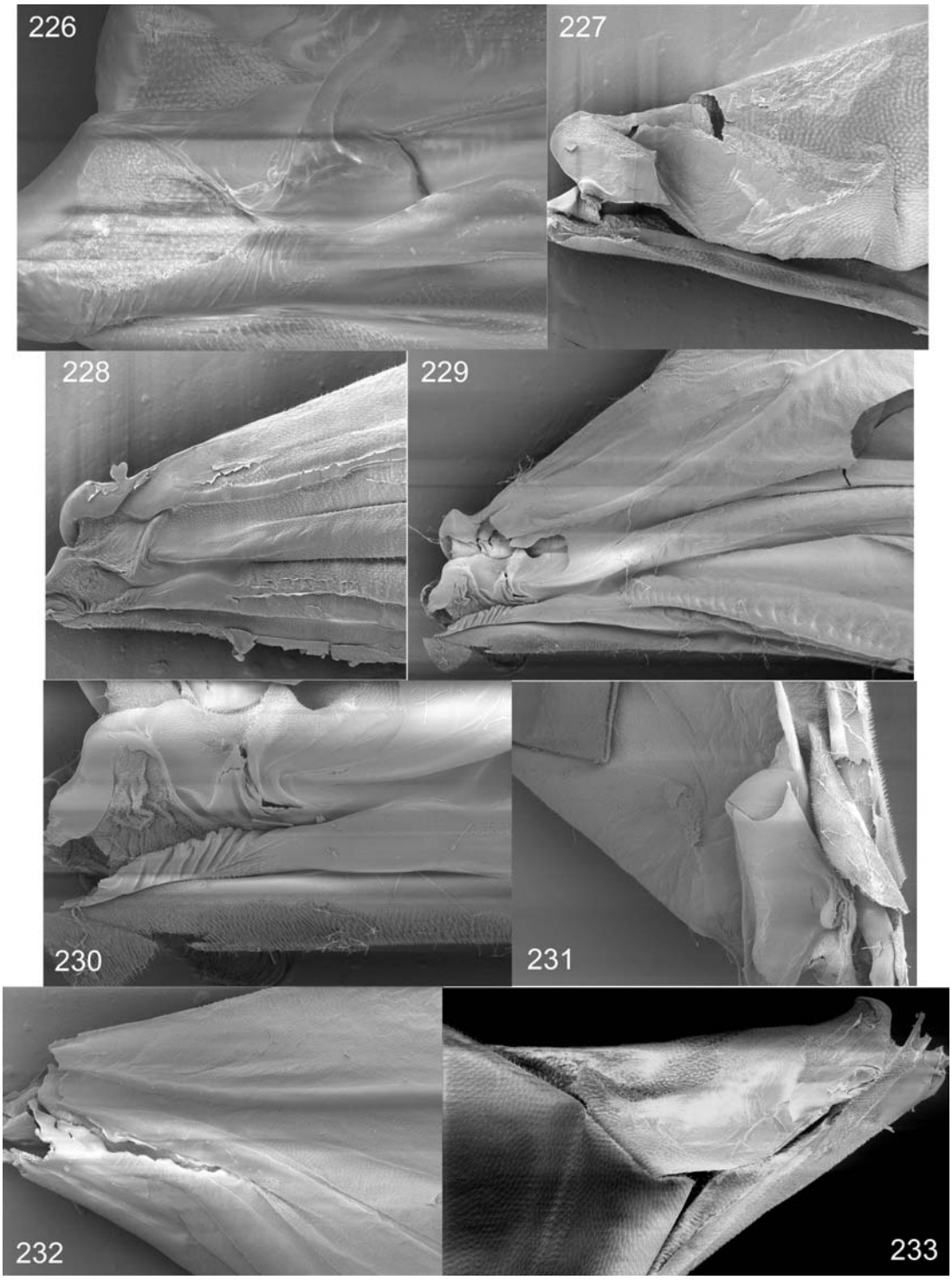
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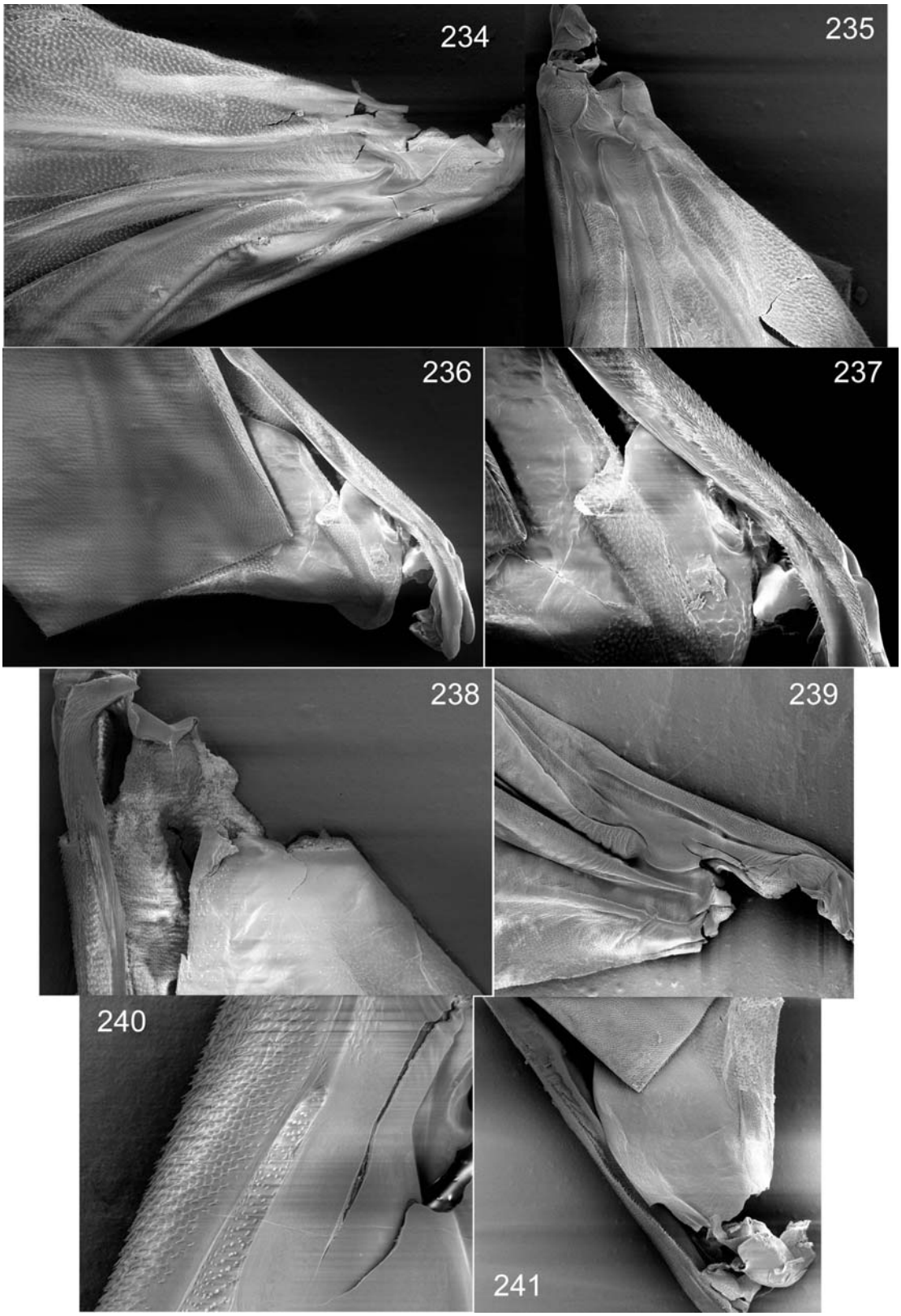
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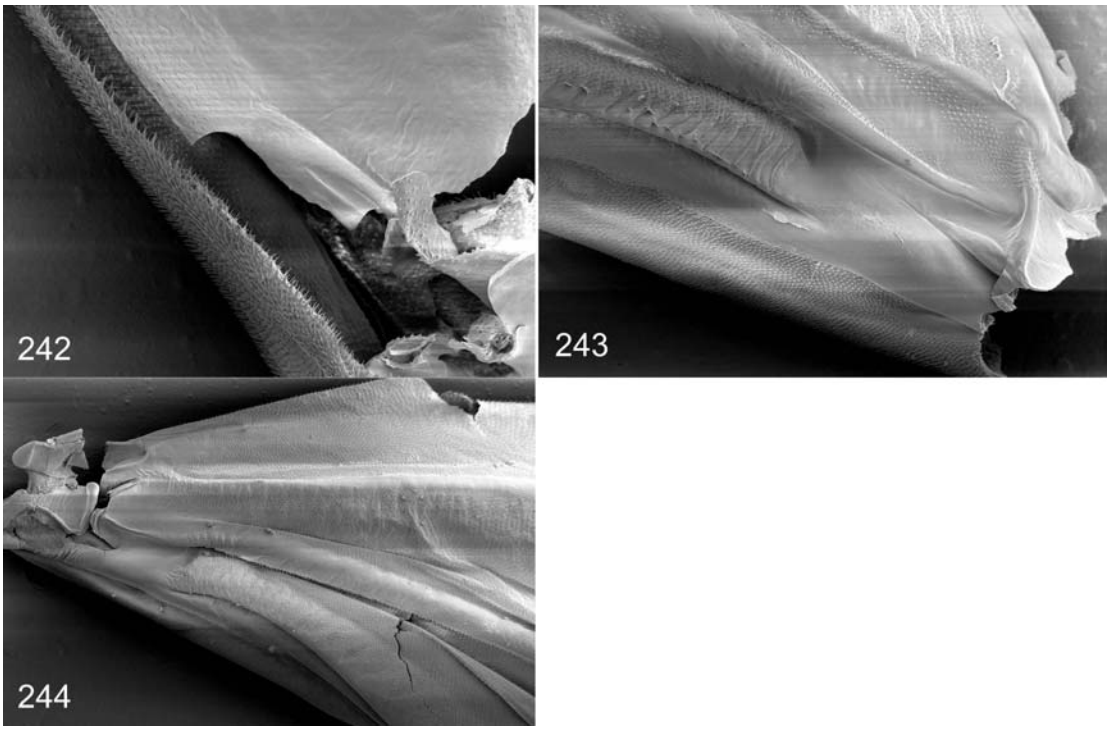
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Chapter VI: Mites associated with pro-thoracic horn cavities in baridine weevils (Coleoptera: Curculionidae)

Abstract

Mite (Acari) phoresy has been fairly well documented in insects and is known to occur in a number of beetle groups. While conducting a phylogenetic analysis of the weevil subfamily Baridinae, mites were found to be associated with the horn sheaths of a number of genera which also possess pro-sternal horns. While mites are commonly found associated with beetles, they have not been documented thus far in weevils. This association is briefly characterized and illustrated.

Keywords: Acari, horn sheath, phoretic, parasite host.

Introduction

Mites have been found associated with a number of insect orders, including Hymenoptera most notably various groups of solitary and social bees (Engel 1996; Klimov *et al.* 2007; Michener 2000) and Formicidae (Eickwort 1990), Lepidoptera, Odonata (Andrés and Cordero 1998), Diptera, and Coleoptera (Silphidae, Curculionidae, Tenebrionidae, Staphylinidae, Scarabaeidae, Chrysomelidae, Carabidae, Lucanidae, Cerambycidae, Passalidae, Elateridae) among others (OConnor 1982). The list of insect-mite associations is slightly less among the more common associations with mites in Mesostigmata, and a comprehensive review can

be found in Hunter and Rosario (1988). Some mites have also been utilized as biological control agents towards other mites as well as towards some insect pests (McMurtry and Croft 1997). In Curculionidae, mites in Podapolipidae (Actinedida) have been recorded on the genus *Hylobius* (Molytinae; Thomas *et al.* 1967). Mesostigmatan mites have also been recorded to occur on extant weevils in Dryophthoridae, as well as on extinct dryophthorids (Davis and Engel 2006). It is assumed that mites are phoretic on weevils, as no documented cases of mutualism or parasitism with or on weevils exist to date. However, it is peculiar to note that many dryophthorids, both extant and extinct, appear to be found associated with similar mesostigmatan mites, those disc-like and flattened, indicating a long history of association with a restricted group of mites. Furthermore, the mites usually are found attached to the legs, often the hind legs.

It appears that no mites have been recorded to occur on weevils in the subfamily Baridinae, although this shortfall has likely been the result of a lack of researchers in this group. Through examination of 231 baridine genera (see Chapter 1) during a phylogenetic analysis, several baridine genera were noted to bear mites in their horn sheaths. Herein, mites of the suborder Mesostigmata are described to occur in the acarinarium/prothoracic cavity (horn sheath) of the baridine weevils *Camelodes leachii*, *Xystus ater*, *Orissus meigenii*, *Linonotus regalis*, *Linonotus distinctus*, *Nedestes sarpedon*, *Pseudosaldius conjunctus*, *Parasaldius longipes*, *Parasaldius sedulus*, *Dactylocrepis pinnatitarsis tubifera*, *Dimesus thoracicus*, *Nestrada inflatula*, and *Stegotes honestus*.

Materials and methods

A few mites were removed from the weevil specimen and heated in KOH for approximately 10 minutes. The mites were subsequently mounted on a glass slide in Euparal mounting medium for digital photography. Digital photographs were blended using the montage software Combine Z, and SEM images were captured using a LEO 1550 FESEM.

Description of baridine-mite association

Approximately 10 mite specimens (Figs. 7-16) were found attached to the cuticle of the concavity located between the prothoracic horns of the weevil specimens (Figs. 1-6). Many genera within Baridinae possess elongate horns projecting anteriorly, protruding from the prothorax ventrally, just anterior to the procoxae (Figs. 1-2). Many also possess a deep concavity (the horn sheath) between the pair of horns, although some only bear a shallow depression. It is in the horn sheath where the mites were found. Three to four mites were positioned near the rim of the concavity, while the remainder were attached along the bottom at the terminal end of the sheath (situated deep inside of the pronotum).

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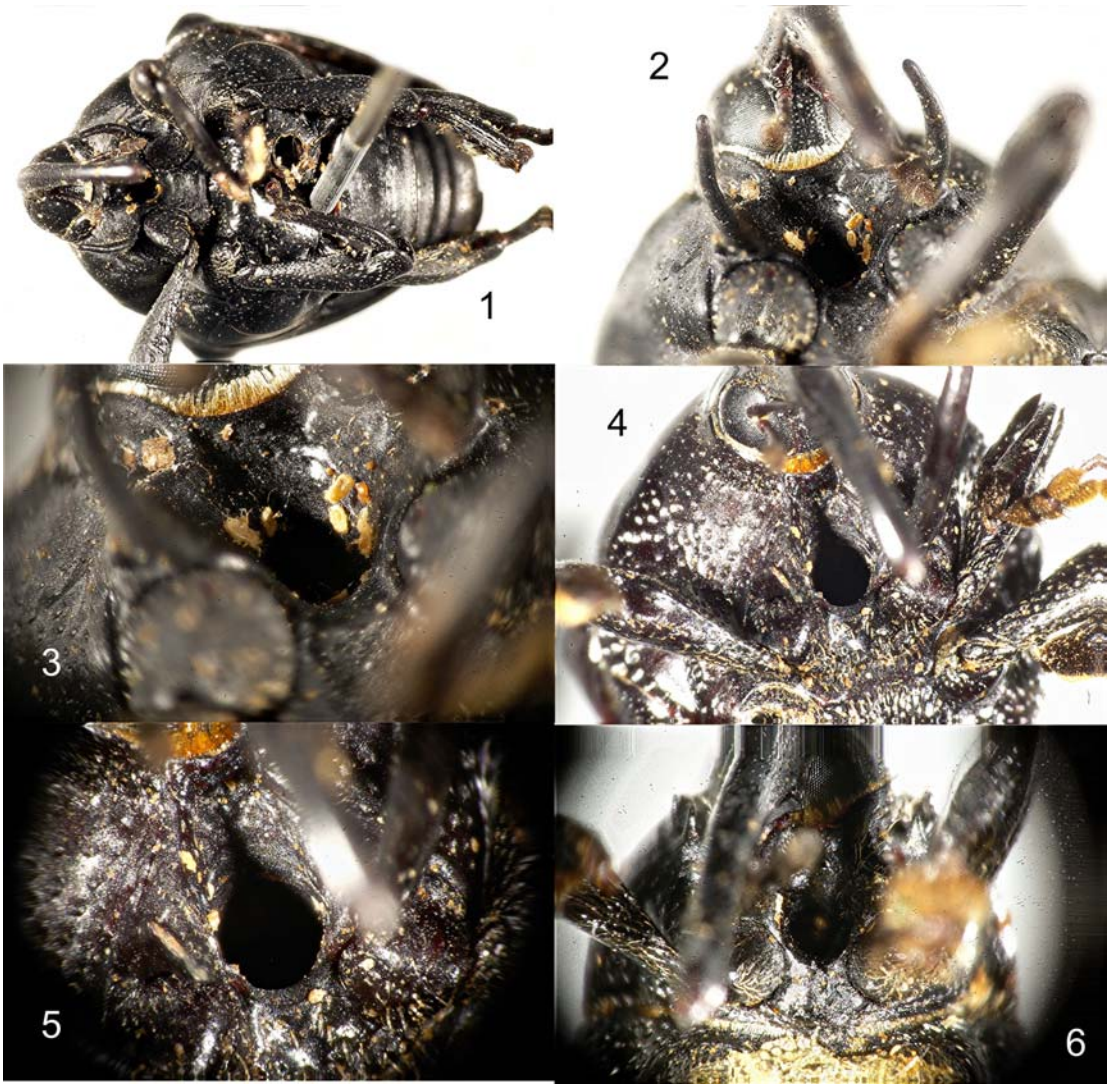
Figure captions

Figs. 1-6. Adult photos (ventral view), showing mites in horn sheaths. 1-3, *Camelodes leachii*; 4-5, *Orissus meigenii*; 6, *Xystus ater*.

Figs. 7-10. Photos of mites. 7-8, dorsal view; 9, enlargement of anterior region; 10, enlargement of posterior region.

Figs. 11-16. SEM's. 11, ventral view; 12, dorsal view; 13, enlargement of posterior region; 14, enlargement of anterior region; 15, dorsal view; 16, enlargement of posterior region and dorsal setae.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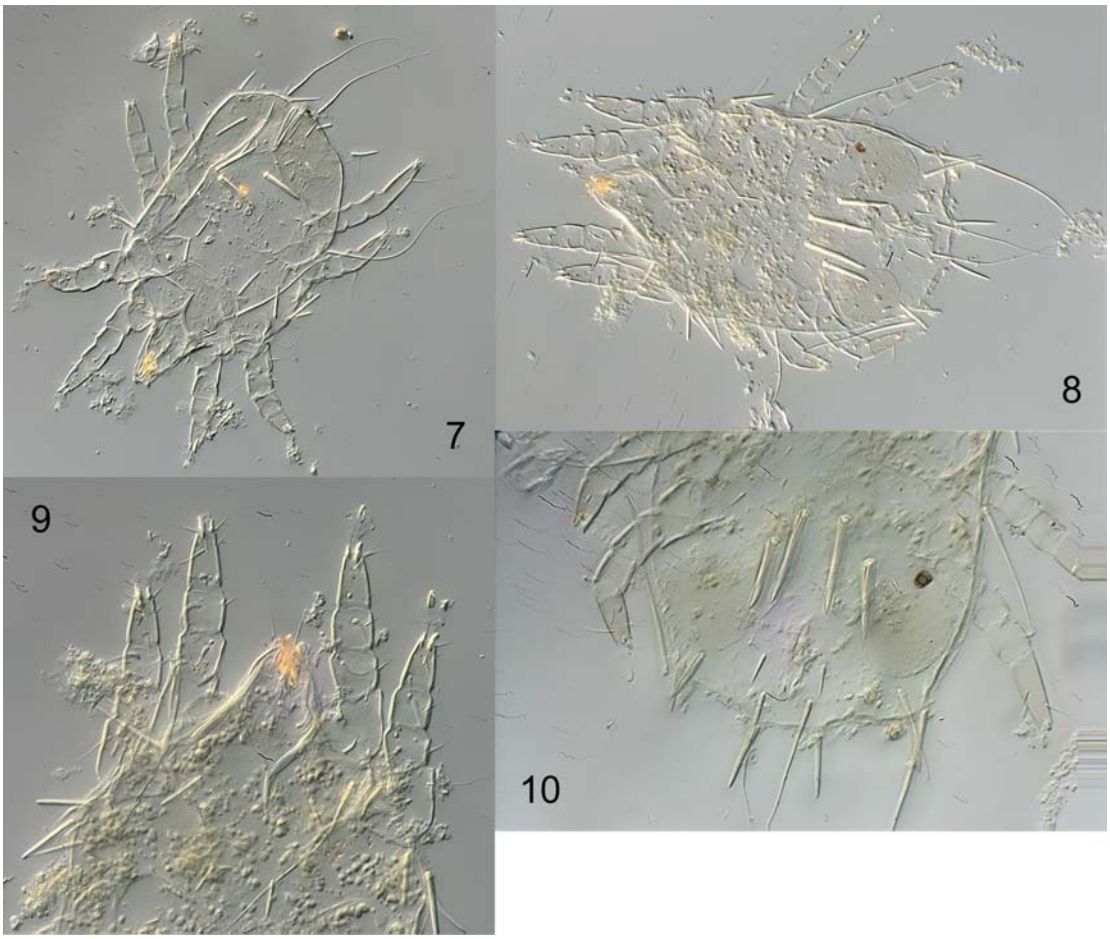
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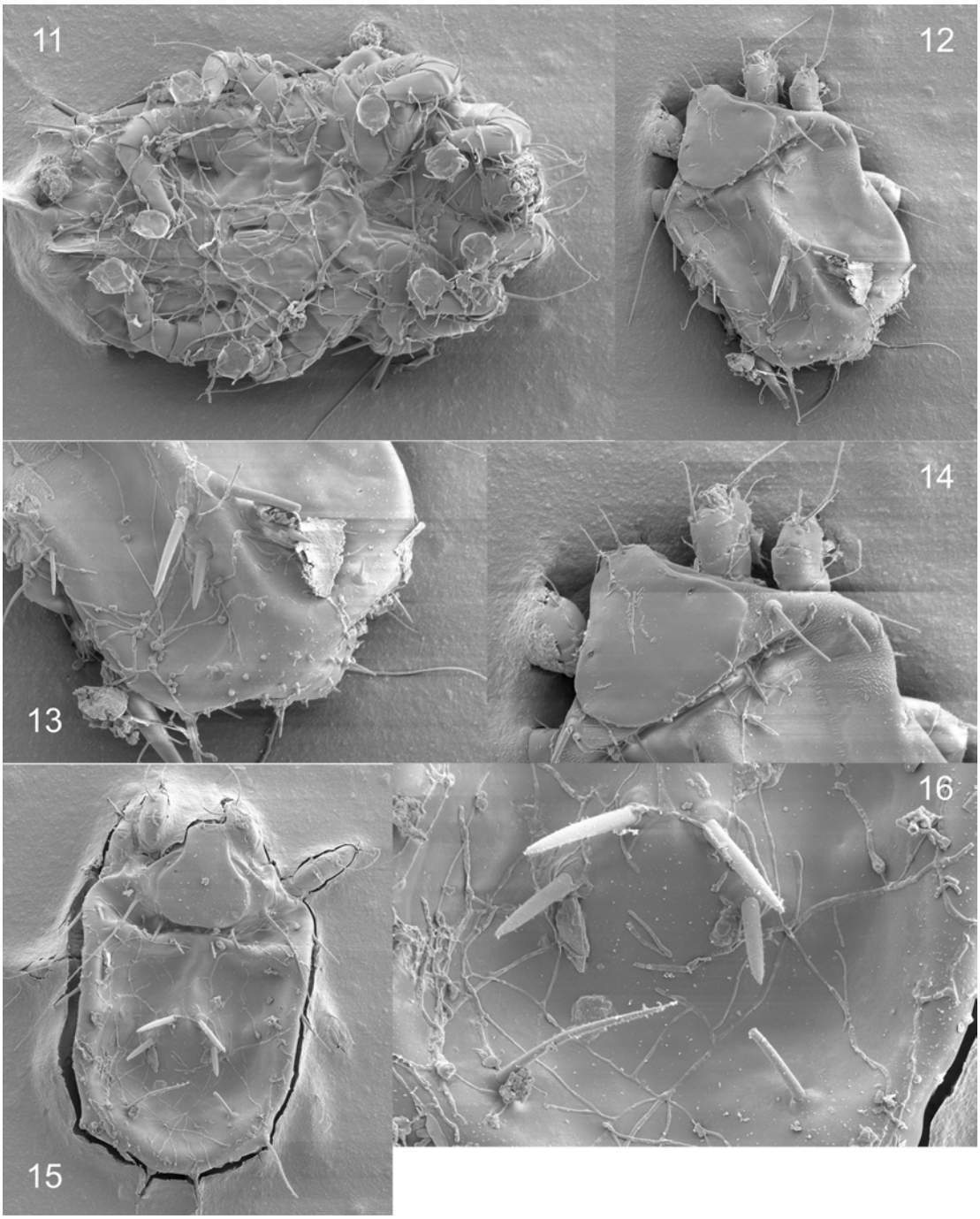
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